INDUSTRIAL RELATIONS.

Address to the Institution, Manchester Section, by Alexander Ramsay.

I AM very glad to have another opportunity of addressing a Manchester audience, especially one primarily connected with the engineering industry. I do not want to throw bouquets to you—because I am merely here, and putting myself at your mercy to-night—but Manchester, in an industrial sense and particularly in an engineering sense, has impressed me for a very long period now as giving perhaps more attention to the intellectual and social side of our activities,—and now to-night on the question of our industrial relations,—than perhaps a good many other districts in the country. In my view that is a very good thing, because a man cannot properly run a great constructive, resilient industry such as engineering unless he is big enough in himself and broad enough in his mind, to take a wide and generous conception of his problems.

Your Chairman congratulated somebody—your President or your Secretary—on having chosen this subject of Industrial Relations. I am not going to congratulate you at all. I think if you had wanted to please me, you would have discussed that question yourself and asked me to come and listen to the discussion, because, as you know, the outsider very often sees most of the game, and to-night as far as I am concerned it is rather a busman's holiday. I am relying on the discussion which I understand will take place at the end of this meeting, and surely in a critical and analytical audience (and it must be if you are Production Engineers—constructive-minded). I am sure we will have a discussion that will give us food for thought and something to ponder over when we go away.

Nobody would deny, I think, especially in these times, the great importance to everybody in industry, in an executive capacity, of the relations which the one side bears to the other in the mutual business of producing the goods we are out to make. Stability in industry is something of the utmost economic value. If you have unrest, whether it is of an individual workman, or whether it permeates through an industry, you get, so far as it extends, that lack of confidence, that unwillingness of anybody to take a risk in the business, that interference with the sequence of production affecting the cost and generally acting to its economic detriment; it follows, therefore, that all things being equal, if we can arrange

our relations in a friendly, harmonious and helpful way, then it is part of our job as industrial producers to do so.

When we talk about industrial disputes, I wonder sometimes if we take the trouble to get back to the genesis, because a big issue industrially can very often grow out of a small issue in the shop. I have had cases over the years, many of them involving perhaps a dispute in a particular factory apparently turning upon an issue which is set forth, and when you come to probe into it and get right down to the root of the question, you will often find that the real cause of the dispute is not the thing you are supposed to be arguing about, but something that happened in the genesis and the germ has been in the structure of the dispute for a long period of time.

The management, on occasions, may be embarrassed by a foreman who is a little too arbitrary in carrying out his job ; sometimes the management is embarrassed because the shop superintendent, for example, may be a little too unapproachable, and a fellow would rather nurse a grievance than go to the superintendent and get that grievance disposed of ; and often it happens, when trouble arises, that you get a workman, or group of workmen, inclined to take an unreasonable view of his or their particular problem ; and occasionally you get a representative of a trades union in the shop who is perhaps swollen a little by the sense of his own importance and succeeds in discovering problems which would never have arisen had he not been so zealous in performing his job.

These are minor factors, but they are important. How are we going to handle these as production engineers ? I do not think there is any rule, and I do not think there is any set method. I do not know whether you have found it (I certainly have—and I think it is true not only of engineering but of almost all phases of industry), that you can buy knowledge, you can buy technique—there is plenty of it—but what I think we want to-day in our leaders of production and leaders of industry is that tangible something you call personality, that innate quality of leadership that gets a job done in the right way and in the right time, that brings the other fellows along with you and makes them feel that they are a part of a team. I do not know how you can cultivate what we call personality if it does not exist, but at any rate I think personality can express itself in one particular way, and that is in giving to the workpeople with whom we come into contact a sense that they are dealing with straight people, just-minded people, who will play fair ; and in my own experience as works manager for a good many years, I am perfectly certain that much of the success of production in an individual factory depends on that approachability and confidence that the management has been approached and that the job will be tackled—not perhaps on the workmen's terms exactly—but tackled in a fairminded fashion.

If we are going to define the duties—the functions—of an industrial relationship, I shall be inclined to put it briefly under three headings :—

(1) To keep the peace in industry.

(2) To satisfy the reasonable aspirations of the workpeople as far as possible.

(3) To keep your industry, whatever it may be, on a sound and economic basis.

In regard to these three factors, let us examine them briefly in turn.

Peaceable Disposition.

The peaceful conduct of industry is not, in this country, a superlatively difficult job provided it is handled with the necessary knowledge and the necessary discretion. We are a well organised and essentially stable people. We are not given to temperamental ebullitions. The democratic sense is highly developed, but it is controlled by a sense of responsibility and that inestimable quality of playing fair which results from an ability to see the other point of view.

In this matter do not despise the little things. Would you think me guilty of an indefensible commonplace if I said that peace in industry, in my view, depends to a great extent on the attitude and aptitude for good will on the part of those who run industry and who represent the parties of either side ?

In my experience I have had to face a great many questions from time to time which appeared to be the obvious cause of the dispute and yet when one probes into them it is found that the origin lies far back, somewhere in a misunderstanding, or a policy, or a disposition to disagree, which form the true cause of the dispute although they do not appear to have any bearing on the immediate issue.

Economic Possibility.

With regard to the second point, I think we do try and succeed, within limits imposed upon us, to satisfy the reasonable demands of the workpeople.

If this island of ours were an economic unit self-contained and self-supporting, in which the service given to us could be recompensed by the service given by us, life would be very much easier. In other words, if by the development of consuming power through the extension of credit, if by speeding up production in one particular industry we could automatically speed up consumption amongst a large volume of consumers, if our costs were entirely complementary and we had nothing to worry about from the competition of outside manufacturers or had no necessity to sell to foreign peoples, then of course we could make our standard of living—which is only another

way of expressing our wage level—what we liked, dependent entirely on our own efforts. But this, unfortunately, is not the case, and brings me to my third point.

Keep on Economic Basis.

It is the business of capital and of management to keep the industries of the country on an economic basis, not only that capital may be remunerated and replaced, but that we shall be able to produce at such a cost that we can sell our production in the available markets. There is obviously no virtue in making an electric generator, or a textile machine, or a locomotive, if the conditions of production are such that a sale cannot be found for that article when it has been produced.

At the moment we are, in respect of most industries of the country, moving on a wave towards better times and we all earnestly hope that this movement will continue. It would be a profound mistake, however, to shut our eyes to some of the essential factors in the situation.

Domestic Spending.

The era of cheap money encouraging capital expenditure, the sums spent on housing and on roads, a certain measure of armament and re-armament, electrification of railroads, the distribution to consumers of national income which was previously saved and reinvested, are all very important factors in the internal situation. One sometimes wonders how long such a situation will last or how it would weather any serious financial or economic crisis that would arise.

I do not wish to depreciate the importance of the home market—far from it. By the wise use of credit, and by the more scientific linking up of the services available by various classes of the community, I am convinced there is a good deal we can do on a permanent basis to maintain our standard of living, even if not to improve upon it. But the fundamental question still remains as to whether this manufacturing country of Britain is, or is likely to be in the near future, a self-contained community, and if it is not then the urge still remains, indeed it becomes intensified, as certain sections of the community become more prosperous, to find an outlet for our product where we have always sold it in overseas markets. The tragic tale of the cotton industry and of the mining industry should remind us forcibly where the fundamentals of our economic life still lie.

Foreign Trade: Then and Now.

It is very difficult, in view of the shifting economic sands during the post-war period, to find a true basis of comparison, but let me

give you an indication of what the position is.

The census of production shows that exports in 1907 were in value probably nearly 60% of the total net output of the country. In 1924 they had fallen to 27%, and in 1930 they were under 22%.

Another rough method of gauging the situtation is that in 1907 exports of goods of British manufacture as a proportion per head of the population of the United Kingdom were £9 14s. 9d.

In 1913	they were	£11	10s.	2d.
In 1924	,,	£17	17s.	1d.
In 1930	,,	£12	8s.	2d.
In 1933	,,	£ 7	18s.	2d.

The position in 1933 is affected by going off the gold standard and exchange levels. They should not, however, differ much from the 1913 position, and it is a fair conclusion that on this basis of computation there has been a considerable worsening of the position.

In engineering, of which I can speak with more intimate knowledge, the proportion of the total production in pre-war days which went overseas ranged round about 48%. In 1924 it was 30% ; in 1929 it was 32% ; in 1934 it was not more than 20%. This has, of course, an enormous significance in the social life of the people.

If we sent an oil engine to a tea garden in Assam, that engine was paid for by tea which was distributed through British households. If we built a railway in the Argentine it was paid for by beef which appeared on the dinner table of British workmen. An irrigation system in the Sudan was paid for by raw cotton. And so, on this complimentary basis we were able to maintain our standards of employment and living.

Balance of Trade.

I have already indicated that the domestic market is receiving a certain stimulus because of conditions which cannot be regarded as economically permanent. There is another factor in the case. In pre-war days we were receiving from investments abroad the sum of approximately £210,000,000 and re-investing in overseas markets probably about £200,000,000. At the moment we have no such surplus for investment because the balance of trade resulting from exports in relation to imports is no longer favourable.

The point I am trying to make is a very simple one.

We must be able to Compete.

In a manufacturing country which cannot under normal circumstances consume its own volume of manufactured product, the cost of production, if we are to balance our industrial accounts, must bear some strict resemblance to the cost of production in other

manufacturing countries. If it does not the inevitable result, under normal trading conditions, is a loss of orders and a loss of employment. It follows clearly, therefore, that the practice of industrial relations, while having the most sympathetic regard to all the factors involved, and especially the human one, must keep its eye on economic soundness, and on account of this cannot afford to buy industrial " peace at any price " which may be demanded.

General Principles of Negotiation.

What are the general principles underlying the practice of industrial negotiations? I have already indicated that the ideal is to keep the peace between capital and labour on terms which industry can afford, but this can only be effected by certain methods and through certain machinery.

Trades unionism is an old growth, but it has seen very considerable development during the last several decades. When the workpeople bind themselves together in a national organisation to pursue their claims against all employers, it is a natural result that employers should combine, not necessarily for the purpose of resisting just claims, but to secure more uniform conditions in the treatment of them.

It would obviously be impossible that the production of machine tools in Manchester should, so far as hours and wages and other working conditions are concerned, be carried on on an entirely different basis from the production of the same commodity in, say, Glasgow or Birmingham. Not only would a wide variation in the treatment of the workpeople cause intense dissatisfaction in certain quarters, but that variation would impose a handicap on certain of the employers calculated to put them out of business through high costs of production.

Therefore, automatically, there arises the demand for some kind of uniform basis which has its result in agreements made by central bodies representing the employers, with central bodies representing the trades unions. The business of industrial negotiation, therefore, is to settle disputes as they arise, to provide means for the proper maintenance of agreed working conditions and for the adjustment from time to time of these conditions to meet economic changes.

How Machinery Works.

Let us see now how this machinery of conciliation and collective bargaining works. I should like to describe to you first the methods employed as between engineering employers and the various unions with whom they deal. Not only because this is machinery with which I am particularly familiar, but because I think, short of arbitration, which really means the intervention and decision by a

third party, it represents probably one of the best examples of conciliation provision in this country.

I shall deal first with the machinery of conciliation. We begin on a basis which is fundamental, namely, that it is the business of the employer and his workpeople to agree on all the day to day questions which arise, if this be at all possible. Our machinery in its first stage provides, therefore, that the discussion must take place between the manager and the workman or men who are concerned in any question that arises. It is only when such an agreement is found to be impossible that the next stage of the machinery is invoked.

Works Conference.

Assuming that the man and his foreman or manager cannot agree on any point in dispute, the men may then ask for what is known as a works conference. The works conference is really a meeting between the responsible management and the workman with certain of his mates, who may be accompanied, should they so desire, by a trade union official. In the event of a trade union official being present, there must also be present a representative of the local employers' association. This is not done on the principle of "setting a thief to catch a thief," but a trade union official permanently employed in pursuing a certain occupation naturally becomes extremely skilful in the reading of agreements, his mind full of precedents, and it is only a reasonable precaution, therefore, that when he is present one similarly equipped from the employers' side should be present also to keep him in a just balance.

You will perceive that at this stage the discussion of a question is still domestic to the works—the conference is held in the works between the management and the workpeople and the two outsiders are only there in the capacity of advisers.

Local Conference.

If the question is settled at this conference, well and good; if it is not, it goes to a further discussion, to which fellow employers in the area become a party. This is known as a local conference. Either the permanent official of the employers' side or an independent employer takes the chair. Other employers are present. The unions are responsible for conducting the case and they may be supported by a deputation of workpeople. The idea of this local conference, you will observe, is to bring into the discussion of what has hitherto been a domestic issue, outside opinion, which may be expected to take a reasonably unbiased view of the question which may be in dispute. Moreover, even lawyers have been known to

disagree in their interpretation of the law, and it sometimes happens that in an industrial agreement there may be two views, not perhaps as to the meaning, but as to the application of certain provisions. To bring fellow employers into the discussion at this stage is sometimes useful, therefore, as discovering what is the public industrial mind, as it were, on the point in dispute.

Central Conference.

If the issue be settled at this stage, well and good, if not, there is still a further means by which conciliation can be sought and if possible obtained. We have a central body which meets at York every month, consisting of representative employers drawn from all over the country. This body, known as the Central Conference, only meets representatives of the executive councils of trade unions and must have no employer or workmen parties to the dispute present when the issue is discussed. This body is in a sense a judicial tribunal, inasmuch as it is called upon to give an unbiased and unprejudiced decision on the facts presented to it. It is in addition an essentially conciliatory body because it does strive to bring the two sides together for the purpose of arriving at an amicable settlement.

In the ordinary course of events there is no appeal beyond this tribunal and if the parties fail to agree the unions are then at liberty to take any course of action they may decide upon. It is provided in our national agreements that no stoppage of work shall take place until this whole series of negotiation stages has been passed through.

National Agreements.

Now these are the day to day questions, but you will appreciate, of course, that there is a range of other questions of great and general importance which have to be settled in another way.

The engineering unions, and this indeed is common to many other classes of unions, while preserving their separate identity and pursuing their own particular interests with all their might, are combined in a federation of unions for the purpose of dealing with matters that are a common issue. Hours of labour, for example, the conditions and remuneration for overtime, payment for work done on holidays, and more particularly, the adjustment of general wage rates, are all carried through by the National Executive of the Employers' Organisations and the representatives of the Joint Trade Unions. Broadly speaking, therefore, the method is that the day to day questions are settled on a local basis if possible—may go to Central Conference—but the broad general questions affecting all

classes of workpeople and all unions alike are settled on a national basis by national conferences between the parties.

You will readily understand, too, that as the result of long years of experience there comes to be built up a kind of industrial case law, a whole set of precedents, which are extremely useful in helping to arrive at the correct solution to any particular problem.

I have already stated that in my view the engineering industry provides one of the best examples of machinery of conciliation and collective bargaining in this country, which means in effect, the whole of the industrial world. It is based fundamentally on the idea that the employer and his workers must agree together if they possibly can, but if they cannot agree, the humblest worker may have his case investigated by various tribunals right up to one that is entirely national in its character. I am bound to say that having regard to the enormous variety of interests in the engineering industry, ranging from the manufacture of steel tubes to the highest type of electrical appliance, from a sparking plug to a motor car, having regard to the fact that we are dealing with over 40 unions, the record of harmony in the industry resulting largely from the provision of this complete means of expression is one of which engineers may be justly proud.

The Mining Industry.

There are of course in this country many other systems in operation more or less suited no doubt to their particular needs. I think I need only mention one more, perhaps by way of contrast, and that is the negotiating machinery in the coal mining industry. The Mining Association represents the coal owners and the Miners' Federation represents the workpeople. Both of these are powerful national organisations, although in fact, they are merely federations of local associations.

The negotiating machinery is largely on a district basis, these districts in respect of both owners and miners possessing a large measure of autonomy. When a local question arises : (*a*) a joint discussion is held between the management of the colliery and a deputation of the workers, failing which, (*b*) reference is made to a special joint committee or to a district conciliation board, consisting of equal numbers of owners' and miners' representatives, failing which, (*c*) the question may go to arbitration by the impartial chairman of the district board, where such impartial chairman has been appointed. The parties, however, are under no obligation to accept the umpire's decision.

The Coal Mines Act of 1930 set up a new body called The Coal Mines National Industrial Board, to which disputes may be referred for investigation and report. This, however, is in no way obligatory

and there is no system for the settlement of local or district matters by any national authority.

The National Board's function is to conduct an inquiry into a dispute and report to the owners and workpeople concerned. The Board has no power to regulate wages and other conditions, yet in spite of this it would appear that colliery owners object to the system, apparently because district conditions would be subject to review by a body, the majority of whom have been drawn from other areas.

The Mining Association, too, is apparently unwilling to discuss wage conditions on a national basis, because they consider this practice unsuited to an industry in which conditions vary so widely in the different districts.

It is not for me to suggest that the Mining Association do not know their own business best. Yet here is an industry, operating in a limited number of areas, producing the same product, not necessarily under the same geological conditions, but with the same class of labour—in which the problem of industrial negotiation ought to be, personal and psychological factors apart, easier to solve than in many other trades where the range and complexity of production is infinitely greater—I sometimes wonder whether the refusal to look beyond the area and to take a wider view of the conditions of production and distribution does not contribute to the unrest which is so notorious in this trade.

Governmental Influence.

There are, of course, other methods of conducting our industrial relations into which Government influence enter directly and indirectly. The first of these is the trade boards which have been set up to deal with the working conditions in industries where organisation was found to be difficult, if not impossible. The Boards consist of representatives of employers and workpeople presided over by an independent chairman, and accompanied by two independent assessors, the last three being nominated by the Minister of Labour.

I think it would be true to say that the trade boards are tolerated as part of our industrial machinery designed to cover a specific section, but not encouraged. Employers do not like control by Government, and the trade unions do not find any enthusiastic response from workpeople covered by the trade board. Broadly speaking, they follow the industrial conditions agreed upon by employers' organisations and trade unions for similar kinds of work.

Then there is the Joint Industrial Council which came into being as a result of the report of a Whitley Commission.

A good many public authorities, for their gas and electric light

undertakings and other similar activities, have set up industrial councils which, broadly speaking, are joint conferences of the employers' and workpeople's representatives.

The trade boards, when they come to a conclusion, have, after certain preliminary stages have been gone through, the force of law behind their decisions ; the joint industrial councils have not.

As a further aid to industrial conciliation, the Government set up an industrial court to which parties may take their cases for arbitration. It cannot be said that in these days this court plays any notable part in our industrial life.

And finally, when a dispute is actually in being, the Minister of Labour may set up a court of inquiry which can take evidence from the parties and report to the Minister on the pros and cons of the dispute.

Relative Values.

I have not the time nor indeed the inclination to try to assess the value of these various methods of settling our industrial difficulties, but we might test the position by certain figures which I have been able to extract. I am not dealing now merely with matters in dispute, I am dealing with actual strikes and lockouts over the whole range of British industry, which have taken place between 1927 and 1934, both years included.

There have been in that period 3,047 stoppages in the United Kingdom. 66.3% of these were settled by direct negotiation between the parties. 17.5% of them were settled by a return to work on the employers' terms.

Now you must not think that this necessarily means starvation or coercion, or the use of the big stick. It very often happens that there is a flare-up and a stoppage, probably in breach of agreement, and therefore of an unconstitutional character. In such an instance it is usual that negotiations should not take place while the men are on strike. If, therefore, a return to work is made on the employers' terms (which really means on the *status quo*), it does not at all follow that negotiation has been eliminated from the subsequent proceedings.

I should be inclined to say, therefore, as a conservative estimate, that of strikes and lockouts at least 75% have been settled by direct negotiation between the parties, 7% have been settled by conciliation (which probably means the introduction of a third party without mandatory powers), and only 1.2% by arbitration.

You will see therefore, from these figures, that so far as actual practice is concerned over this period of years, we like to pursue the method of settling our differences in our own way, and without the intervention, and most certainly without the compulsion, of a

third party. No one could deny that apart from one or two outstanding exceptions, the method has on the whole been singularly successful.

Issues Settled in Early Stages.

Now, I have been dealing at some length with machinery of conciliation and negotiation and have come to the conclusion that on the broad industrial basis each industry likes to handle its own problems. I do not want you, however, to be under any misapprehension. The number of cases which have to go through the whole of the machinery provided is infinitely small compared to the number that are settled in their initial stages. There is no doubt that thousands of incipient disputes are being settled every day in our factories and workshops. Those which get a little further in the procedure are very often disposed of between the local official of the Employers' Association and the local trades union delegate.

As a case in point, may I quote you some figures relating to one area, and to the engineering industry in that area. There were, over a given period, 725 works conferences and/or discussions between the local official of the Employers' Association and the local trades union officials (for the purpose of this examination I put them together). Out of these 725 discussions only 75 of them went into the next stage of negotiation, which was the local conference, where, as you will remember, other employers came into the consideration of the issues. Out of the 75 there discussed, only 41 got to the final stage of the procedure of negotiation.

The moral to be drawn from this is one of tremendous importance. Sometimes a question arises upon which it is impossible to compromise. Sometimes a case is found of conflicting personalities who cannot get together. But broadly speaking, common sense, good will, and a feeling of trust and confidence between the parties, may nip at the beginning and cause to be settled in the friendliest way a dispute which if allowed to develop might ultimately involve large issues and cause serious trouble.

Foreign Countries.

It is extremely difficult to get reliable information as to the actual day to day working of the machinery of conciliation and negotiation in foreign countries. It will be appreciated, too, that there are now very few industrial countries left in the world where the parties are free, as they are in Britain, to come to a conclusion and to accept responsibility for pursuing a policy. I think it might be truly said that Belgium, France, and the United States, apart from ourselves, are the only ones left.

Belgium.

In Belgium, in the event of a dispute arising there is certain machinery of conciliation which has been established by the Government, and which acts apparently on a more or less *ad hoc* basis. The Government may set up a conciliation committee, to which one or other of the parties may refer the dispute. In the event of conciliation failing in the first stages, the matter may be referred to arbitration. In the event of a failure here, a report may be issued to the Government, who, in certain circumstances may assess culpability for the dispute.

France.

In France a dispute may be submitted in writing to the Justice of the Peace of the local Canton. An *ad hoc* committee of five persons from each side may be appointed under the general direction of the Justice of the Peace. The terms of settlement are indicated to and published by the Mayors of Communes. In the event of failure at this conciliation, the parties may proceed to arbitration.

U.S.A.

In the United States of America, the process of negotiation in theory follows more or less the line adopted in this country. It has to be remembered, however, that trade unionism in America has nothing like the same prestige and recognition that it has in Great Britain.

In this country there are approximately 4,500,000 trade unionists out of an occupied population of 21,000,000. In the United States there are approximately 3,500,000 trade unionists out of an occupied population of 49,000,000.

I think it would be true to say that the psychology of the average American employer of labour is definitely against the recognition of the trades unions except in such restricted degree as the circumstances make possible, and that their handling of industrial disputes is characterised sometimes with a degree of violence that is rarely met with in this country.

I do not know that any valuable conclusion can be drawn from this difference in conditions. Industrially speaking, we are a much older country. Trade unionism is a much older growth. We are a much more homogeneous people. American industry in developing rapidly has absorbed a polyglot population from most of the countries of Europe—an industrial population with little sense of independence and little or no sense of community of interest.

An observation of the provisions of the N.R.A., and their recent application, would lead one to believe that those responsible for the political government of the States are coming to the conclusion

that a less arbitrary way of doing things industrially is desirable, and it may be that as time passes the tendency will be for the American continent to organise itself more on lines such as those to which we are accustomed in this country.

Germany and Others.

I do not propose to deal with negotiating machinery in Germany, in Italy, in certain states of America, or in Japan. It is true that there are conciliation boards set up which act in certain circumstances, but I think it must be obvious to everybody that industrial relations in these countries are overshadowed, restricted, directed, and even controlled, by political circumstances. It seems to me that from this broad comparison another important moral can be drawn.

A Moral and a Responsibility.

Great Britain is still pre-eminently the home of the independent employer, the independent worker, and of freedom of negotiation and action. There would appear, therefore, to be an especial responsibility on the shoulders of all of us, on both sides, so to conduct our mutual relations with tolerance and understanding and a sense of justice and of discretion, that under no circumstances would it be considered necessary by political forces representing the great body politic, to interfere with the unfettered conduct of our industrial affairs.

British Conditions Best.

I make this plea, which is directed to trades unions just as much as to employers, because I am convinced that the conditions of the British worker, not only in an industrial but in a social sense too, are incomparably better than those of any worker in the world, not excluding those of the United States of America.

In making out your industrial balance-sheet, wages is only one factor in the account, but even then having regard to our cost of living, and particularly to the necessity of keeping the cost of our production on such a basis that we can find a ready market for it overseas, the general standard of wages can be defended on an actual and relative basis. But security too, is a factor of supreme importance in the life of the working man. The deadly terror of the working class housewife is not so much that wages may vary by 2s. or 3s. per week, but that the bread-winner may find himself out of a job upon which he will have to fall back on social aids which, although valuable, cannot compensate him for the loss of wages.

Our problem, therefore, is not only one of wages, it is one of wages and continuity of employment, and the trades unions and workers,

and employers too, would make a profound mistake if they thought that because of adventitious circumstances or temporary conditions, these two can ever be separated.

Social Services.

When we speak of wages, let us not forget one very important fact. I sometimes feel that there is a disposition in certain quarters to attempt to put our industrial activities, as it were, into water-tight compartments, as if industry can be segregated from the social life of the people. Yet is it not true that whatever is consumed in any form must first of all be produced, and just because we are not, and cannot hope to be, within any reasonable period of time that can be envisaged, a self-contained people, it is equally true that much of what we produce we must exchange for the commodities we want to import from other countries. The point I want to bring out is that all social well-being, of whatever form, whether it is in food, clothing, housing, or education, is paid for by the proceeds of our industry and is in fact, and can never be anything else, another form of industrial wages.

In 1910—which is not going very far back in the life of a country, our annual expenditure on social services, including unemployment insurance, health insurance, widows' and old age pensions, education, public health, working class housing, and poor relief, amounted to £63,250,000 per annum.

In 1933, which is the last year for which the Treasury have given figures, these same services amounted to the enormous sum of £479,000,000. Keep in mind that this great increase is, of course, taken from the proceeds of our industrial activities. Bowley and Stamp estimated that in 1924 our industrial wage bill was in the region of £1,600,000,000 per annum ; 1924 was not an unsatisfactory industrial year, and we might conclude therefore that this sum of £479,000,000 represents industrial wages equal to about 30% of the total sum distributed in wage bags over the course of the year. There is no other country in the world which can show such a record and I think it is only reasonable that those responsible for the conduct of industry should have this put to their credit when British industrial relations are properly analysed and their value assessed.

Commercial.

There are only three more points with which I think it necessary to deal. Industrial relations involving negotiation and conciliation are, of course, concerned with the producing side of industry, but the producing side of industry cannot properly be dissociated from the whole of industry and I wonder, therefore, whether sometimes closer working is not desirable between the commercial side and the works.

I believe we are becoming more sensible in the development of contact between the various manufacturers in relation to selling, but there have been periods in our industrial history where, without any very obvious need, our manufacturers have been cutting each others throats in order to get orders, taking work clearly at a price which involved no profit, and sometimes a loss. The repercussions of such a situation had, of course, to be passed on to the works, and certainly did not make easier the course of industrial relations. One cannot, of course, lay down any specific line or an arbitrary rule in these matters, but it would be, I think, a mistake if lack of co-operation between sellers were to make the problems of production more difficult than otherwise they need be.

There is, too, a question of delivery dates. Has it not been observed that consulting engineers, public authorities, and other types of customers who have orders to place are inclined to sit upon the order until the very last moment? The salesmen are always ready to oblige and take the order on delivery dates which, to say the least of it, are shorter than is desirable. The result is haste, sometimes disorganisation, sometimes overtime in the works, all making the lot of the poor producer more difficult than is necessary.

At the moment it is not inappropriate to raise these questions in respect of another sphere. I have already indicated that a considerable measure of the prosperity we are enjoying at the moment is coming from the exploitation of the domestic market. Is everything being done here to control the situation from the manufacturer's point of view in the best way? The Government itself has three main spending departments—the army, the navy, and the air force. It would be interesting to know just what degree of co-operation exists between the buying services of these three great departments, all of whom have to get their material, broadly speaking, from the same source. Are they competing for suppliers, are they competing for delivery times, or are they working closely together in order to fit their requirements into the economic structure of industry in the way best for industry and for the country?

Future Developments.

It would, in my view, be a mistake to suppose that our industrial machinery is in a static condition. The trades unions in the past have organised themselves on a horizontal basis. That is to say, we began with the skilled men of various classes in an industry who had their own trades union. We came to various permutations of unions dealing with semi-skilled workers and others confining themselves more largely to the purely unskilled. I am inclined to say that as time goes on we shall have some evidence of a change in this general practice. It may not be imminent, but I think the time will come when there will be evidence of a tendency to organise

not on a horizontal basis but on a vertical or industrial basis, including many or all of the unions in one industrial organisation. If and when such a movement should develop it might well be that we should have to adjust our method and discover some means on the employing side of balancing the more consolidated forces that would then be presented from the other. Should such a circumstance arise, I should be in no way alarmed, because the fundamental basis of our relation would still remain, namely, that through industry we had to produce not only our own living but the living of all our fellow subjects in this country, and I have no fear that this responsiblity, which I feel would still be acknowledged, would lend to our counsels that sense of wisdom and restraint that would carry us through, as now, in most cases to a friendly conclusion.

My last word is this. There is very little legal sanction in industrial agreements. The trade boards have it, and the cotton industry was recently given some statutory power by the Cotton Manufacturing Industry (Temporary Provisions) Act, which has a main purpose of making compulsory upon a minority of employers any schedule of minimum rates which may be arrived at by mutual agreement between the majority of the employers and the trades unions. Broadly speaking, however, under our system of negotiation, by which we arrive at agreements with a union or unions, there is no force of law behind such provisions. I want to suggest to you that this fact makes it the more imperative that when an agreement is entered into both sides should observe it in the spirit and the letter.

The employer who tried to evade the plain meaning of a collective bargain would be doing a disservice not only to the employing class, but eventually to himself, and the trades union or the worker who took a similar line of country and sought to exert pressure beyond the limits of his bond, would be prejudicing the interests of the working class by making negotiations likely to lead to his advantage more difficult in the future.

Out of an experience rather long and very close, I would say to you this : Given on both sides a sense of honour and understanding, a willingness to admit that the other man may have a point of view, the general application of that sportsmanship and sense of fair play which does above all things spread confidence and trust, I have no personal doubt that our industrial relations will continue peaceful, and, I hope, profitable as well.

Discussion.

MR. G. E. BAILEY (Chairman) : On the two previous occasions when I have had the honour of presiding at similar meetings—we have been addressed by Mr. Hichens and Sir Herbert Austin—both these gentlemen spoke to us and put the case for industry from the point of view of two of the leaders of industry, but I am quite sure that both of them would have agreed with all of us here that industrial relations are a very important factor to successful industry. I therefore want to congratulate the Institution upon the choice of this subject, particularly on being able to obtain as a speaker Mr. Ramsay. Mr. Ramsay is in the unique position of being the advisor—the spokesman—of the National Federation of Engineering Employers, and in that position he is able to see both sides of the question. His natural inclination, shall I say, is to the employers' side, but I am quite sure from the broadminded manner in which he tackles all his problems that at the same time he has in mind the interests of the other side, which is labour. It is not part of my duties to enlarge in any way on the subject or start a discussion.

MR. PETRIE : We must be very grateful to Mr. Ramsay for filling our breasts with that rosy glow that comes to us when we realise—he has nearly made us realise—that all is for the best in this best of all possible worlds. Until I heard him speak I had not realised there was a Kingdom of Heaven upon earth—it must have crept in like a thief in the night ! There are one or two points still lacking, to my mind. It seems to me that what Mr. Ramsay had to say was expressed in his three points, i.e., industry was always striving to obtain, first, to keep the peace in industry, second, to satisfy as far as possible those who are working in industry, providing third, that industry was kept sound. There we have the whole keynote of the industrial problems that disturbed the world, and still disturb this country. We must satisfy those who work in industry providing we keep industry sound. Superficially it seems a very reasonable argument, but it is only reasonable if we examine the case as it is presented to us. Is it possible that the genesis of trouble in this vast machinery of conciliation that has to be maintained lies in our habit of putting industry first and mankind second ?

Let us look at our industrial relations. I, as an employer, look to my own interests. I look also to the interests of the consumer, or customer, just so far as it is necessary in order to safeguard my own interest in the long run—and no further. I look to my own interests in my dealings also with those whom I employ, just so far

as will give me the best economic return, and no further. The works manager has interests to serve, and his first interest is himself and his dependents; but he serves that interest by watching my interest, and he watches my interest just so far and no further as is necessary to preserve his own. Take the manual worker. His interest is himself and his dependents. He has a secondary interest: He must keep on the right side of his foreman. His third interest is, that he must be loyal to his trade union—perhaps the most generous interest of the whole lot. How can you expect to get really sound industrial relationship when not only our interests are pulling in different directions, but one man is torn between two, three, or even four interests? Is not this also another aspect of the same genesis of the problem of industrial relationsip? When we can find a means (and I think a means can be found) by which we shall work together with a common interest, then we may arrive at real industrial relationships that are worth calling relationships and will not need a vast machinery of conciliation to keep the peace. Just one other point. Two references were made to the brighter prospect of industry arising from armaments and rearmaments. This is another aspect of the same thing. Are we in trying seriously to talk of industrial relationships to forget all other relationships and seriously to pride ourselves, and even be grateful for, the means of sustaining our interests at the expense of human life?

MR. LAUDER: The speaker mentions other industries than engineering. At the moment the country is facing the difficulty and the possibility of a coal strike. The employers say that they cannot afford to pay the amount of increase which is asked for by the miners and they have in various ways suggested increases in prices of coal. Well, the engineering industry, and other industries, are so very seriously concerned, or should be so concerned, at the possible effects of a strike in the coal industry, that it would appear that the Engineering Employers' Federation should endeavour to assist, with other bodies possibly, in saying what settlement is possible. Relations in the coal industry have certainly a very definite bearing on the relations in the engineering industry.

Adverting to the last speaker's remarks—I think he mentioned the common end. The unions in claiming advances usually disregard the effect of the advances which they are claiming, and I think industry as a whole (shall I say the capitalistic side of the industry?) should from time to time take steps to educate public opinion in return for the capital which is being invested in that industry. This should not be done in spasmodic fashion, and at a time when there is apparently need for it because there is a demand, but it should be done fairly often; and possibly the history of these returns of capital should be put before the public so that the public

may be educated so that they can, in the event of a dispute, have some idea of the cause of the dispute.

I would like to say I have appreciated the speaker's remarks about the beginnings of disputes. In the early days of industry a works manager knew every man in the factory individually by name, and from his daily association with these men he not only avoided trouble, but he knew individually what they wanted. He had to know what they wanted : it was too late when they started asking ! In the large organisations nowadays it is impossible for any one man to know all the people in his works, and, therefore, he will delegate that responsibility to superintendents and foremen. It is their duty—and their first duty, shall I say—to act as thermometers. They want to know what the people are thinking ; they have to know what they are thinking, so that any serious dispute will be forestalled.

MR. SYMES : The speaker made the point that the Federation of Employers was necessary to ensure uniformity of working conditions. One point which the speaker dealt with close to the end of his remarks was the general fear of insecurity. One cause of unemployment, whether we like to recognise it or not, is the large and very speedy growth in manufacturing technique. The day has gone by when anyone can devise a policy of increased manufacturing efficiency by saying that if you only make the goods cheap enough you will sell more of them. That may hold for a particular works, but it does not hold nationally. Last year in Manchester a lecturer gave an outline of how the chemical industry was approaching this problem. They were setting themselves a scheme of conpensation for men displaced by improved manufacturing efficiency. I maintain that one of the main obstacles to the advance in improvements of manufacturing efficiency is just this feeling of insecurity, and I think that if some form of compensation for displacement due to increased manufacturing efficiency could be devised, it would make one of the greatest contributions to progress.

MR. CRAVEN asked if the Employers' Federation had negotiations with the non-federated employers, and asked for a lead as to what should be the attitude of a trade unionist to the non-trade unionist in workshops.

MR. WALMESLEY : Mr. Ramsay explained at some length the various stages of the conciliation machinery in the engineering industry. I would like to ask why is there no finality at any stage—particularly the last stage—of these proceedings ? The Federation, which is represented by Mr. Ramsay, always sets itself against that policy, and I would like to hear some considered reply to that question. I notice in the figures Mr. Ramsay gave he was careful to refrain from saying in how many cases the dispute ended like this : " The parties were unable to arrive at a mutual settlement."

MR. RAMSAY : I am very much obliged to Mr. Petrie for his very interesting observations. His mind was quite obviously—I won't say dominated—for the purpose of his speech, but closely associated with a social philosophy of which most intelligent people have knowledge. I would just like to remind him, of course, that is not what I came here to discuss to night. I was not concerned with whether capitalism or anti-capitalism was the better thing for this country ; I was not discussing the question of whether all production should be for the service of the community or whether it should not. I might be prepared to argue with him as to whether our national organization of production and distribution is so very far from the ideal to which he sets his mind within our economic limitations. I did not come to discuss that. I came to discuss with you the machinery existing for doing certain work and certain implications that arise through the conduct of that machinery.

I must correct Mr. Petrie on one thing. I did not say,—I certainly did not intend to convey—that my view of this country of ours, with all the many problems we still have left, was that everything was for the best in this best of all possible worlds. Of course not. I hope to live a long time and I hope I shall see conditions for my fellow citizens of all classes better and more secure than they are to-day. I was dealing with things of reality. What I did say, and what I reiterate, is, that our machinery for negotiation and conciliation in this country is better than that of any other country in the world, and I hold to it. I said further that the results of the operations of that machinery in maintaining peace and distributing a certain volume of the products of our activities to our fellow citizens were, in my judgment, also the best in the world, and I maintain that again. Ask yourselves whether, as engineers, there is any other country you would rather live in than England ? This is an answer, and, I think, a conclusive one. Just one other point. I did not say, of course, that in all disputes with which I came into contact from time to time that one had to probe back to the genesis. I said—one often did, and found there was a genesis—which does not really affect the argument and my conclusions. I was merely pointing out that, after all, a certain amount of meticulousness is desirable when you are replying to each other.

What was wrong with my three points ? Peace—I do not believe that whatever anyone's social philosophy may be, he would seek to depreciate in any way efforts that made for peace in industry ; and I still maintain that our efforts in this country are not such, broadly speaking, for which we need apologise. I suggested our second business was to satisfy the reasonable aspirations of our workpeople, conditional upon keeping the industry sound, but Mr. Petrie seemed to have rather a difference of opinion on the question because I placed soundness of the industry in conjunction with reasonable

goodwill and remuneration. The answer is obvious. If you cannot keep sound industrially, if you cannot do your job of producing goods and selling them, you will have no remuneration to distribute at all. I make no apology for the emphasis I placed—and which I repeat—on the absolute necessity in the interests of our workpeople in keeping the means of livelihood on such a sound basis that they can look forward to some degree of continuity and security.

Mr. Lauder made a similar point in relation to conditions in the mining industry. I think you will have to excuse me if I do not attempt to go more fully than I have done into the mining situation at this juncture. After all, we have enough troubles on our shoulders to run our own industry without seeking to bear the troubles of another industry. Apart from all that, when two sections of people are in dispute and in a critical situation, I am not sure that the worst possible thing that could happen would be for responsible people in other industries to enter in at that particular moment with gratuitous advice, and I, personally, hope that the negotiations will have a fruitful and peaceful result; and I thing the whole of the people in this country hope that out of these negotiations the miner himself will get some amelioration of his conditions.

Mr. Symes raised a very interesting question—not a new one—but nevertheless one of perennial interest. He pointed out that in engineering, although we have all this machinery for effecting uniformity, there were certain differences of conditions. I was not going into all the details covering the whole of the operations of a great industry—obviously, I could not do that. There are some minor differences in the basic rules throughout the country. What I was trying to demonstrate was that big movements for the regulation of working hours, conditions of overtime, and adjustment of wages which have now been carried on for thirteen years on a national basis, necessitate a national organisation, and it was in the sense of the operation of a national organisation covering the whole of the industry that I was talking about uniformity.

Mr. Symes made one interesting observation. He said that we had now all given up the idea that development in technique of production that cheap production necessarily meant more for the consumer. I was not aware that we had given up that idea at all. I have not given it up; and I venture to think that you will not find a responsible economist in this country who has given it up. I believe that the advent of the motor car ranging from £100 upwards has created a tremendous demand for motor cars which would never have arisen if the prices had been on the high levels of the pre-war days. I believe the same thing applies in the tremendous demand for wireless, electrical lighting, and other amenities which make life a little more easy and pleasant.

Mr. Craven asked two definite questions. Do I believe in the Employers' Federation negotiating on behalf of non-federated employers? The answer is in the negative. We do *not*. We have no lot or part or dealing or responsibility for a non-federated employer. I sometimes regret, however, that we do spend our money and our time and our labour—and one or two of us have sweated blood in keeping the peace and getting a settlement, and then the non-federated employer just steps in and takes all the benefits.

The other question was in regard to the trades union, and what is our attitude in regard to the non-unionist in the factory in relation to the trade unionist. We take the view that in regard to membership or otherwise of a trade union the British working man is a free subject and can please himself. We do not lend ourselves either to asking a man to join a trade union or insisting on a man joining a trades union. It is a matter of individual freedom, and a man may, as far as we are concerned, do as his conscience directs him.

It really was not necessary for Mr. Walmsley to vindicate my character by suggesting that you do not think I was wilfully trying to mislead this gathering. I know that unemployment, insurance, and other forms of benefit, etc., were not in existence in 1910—I know that. I also know that they have got to be paid for now, and how are they paid? By taking some part of the proceeds of the production and directing that part to the specific object. My point is clear and unassailable. These are social benefits which we have to earn in industry and they ought to be put down to the credit of the industry, whether employer or workman.

The other question was the finality of the conciliation machinery. You take your machinery to a certain point, and then, if you cannot agree, you cannot agree—but why not go on as in the Law Courts and get a decision which I suppose both parties would have to accept? That is a question I cannot enter into to-night. It means, of course, compulsory arbitration. In view of the rather meagre results which arbitration has given so far, and the small part it has played in industrial life, I am inclined to think the disadvantages of compulsory arbitration are just as obvious to the workpeople's side as to the employers'. In compulsory arbitration, you are really putting the issue into the hands of somebody else, and it does not necessarily follow they would be as competent to deal with these issues as perhaps we ourselves.

THE PRODUCTION OF IRON CASTINGS.

Paper presented to the Institution, London Section, by H. Field.

YOUR Committee's invitation for the reading of this paper was accompanied by several questions to which they drew the author's attention. For the most part, these concerned matters of fact, but the first query " Why are castings not generally better than they are ? " is rather a matter of opinion and somewhat more difficult to answer. We have had the privilege of reading papers on foundry matters to makers, users, and purchasers of castings, and have welcomed the criticism or discussion which has arisen, but the challenge now presented, coming as it does before the paper is read, has given rise to much anxiety and apprehension in our minds. Facetiously, we have imagined the question originating from an examiner desirous of witnessing the victim under torture, or again, as the work of one who, has purchased castings in a too cheap market, and obtained his reward. A query so vaguely defined might legitimately be dealt with in an evasive manner, but it is hoped that the paper may provide some satisfactory reply. On the other hand, the authors are relying upon an accompanying film to demonstrate " why iron castings are as good as they are."

Seriously, the question is a disconcerting one, coming as it does from an association of consumers or purchasers so representative as your Institution. Our industry would not welcome the implication that castings in iron are more unsatisfactory than those in other metals, or that the progress of the engineer is limited through our inability to meet his requirements. We should indeed be disappointed to feel that engineers as a body are dissatisfied with iron castings in general, if and when these have been purchased from a firm of repute and experience, and at a price which should be fair and economic to both parties. During the past twenty years, the practice of ironfounding has made enormous strides both in method and material, and has kept pace with modern engineering development, and we should hope, therefore, that iron castings are not the last resort of the engineer, to be used only when there is no alternative. Cast iron may not be an attractive material, admittedly it rusts quickly, breaks easily, and yields dust rather than spectacular spirals in machining, but the objections of the engineer must be based on more serious failings than these.

Cast iron has suffered replacement in many directions and new

developments threaten or occur from day to day. These include many domestic items; mention may be made of aluminium for saucepans, tiles for grates, enamelled sheet washing boilers, rubber-rollered wringers, wooden bedsteads, and asbestos rain-water pipes. The electrical industry, although mainly a growth of the present century, is already substituting bakelite or steel sheet for cast iron in switch boxes, and adopting fabricated structures for generating frames. Another newcomer, the automobile trade, has discarded cast iron for aluminium in pistons and gear boxes, for die castings in shock absorbers, and for bakelite in distributors. This survey might be extended over other industries and would reveal a constant erosion or landslide by changing fashion or design and by the perfection of competitive materials.

On the other hand, cast iron has played an amazing part in new developments. This is borne out by the President of the Institution of Mechanical Engineers, who recently stated that cast iron constitutes two-thirds of the raw material for the engineering trades. The domestic goods of earlier days were admittedly beneficial to the foundry on account of their weight and that they could often be made from cheap or nondescript material. Thus "bedstead iron" became a term descriptive of low grade iron, largely comprised of scrap, whilst the old type wringer frame, although of ample design, certainly lacked the super-finish possessed by high-class castings to-day. Three instances may be quoted in illustration of the far more exacting demands now made on the founder for domestic goods: electric irons, of which the bases must be free from pinholes for chromium plating; hotplates for electric cookers in special heat-resisting metal, or in non-magnetic cast iron; and thirdly, high pressure cylinders for refrigerators. The development of gas and electric cooking stoves has created an enormous market for cast iron; at first sight, it might appear that the modern vitreous enamel finish lessened the demand on the foundry when compared with the all-black cooker of earlier days, but this is by no means true. Only certain compositions of iron lend themselves to ready enamelling; small irregularities on plain surfaces are intensified when the glossy reflecting finish is applied, and the smooth casting skin, so much idealised in the artistic era, has been found intensely productive of small gas bubbles when heated in the enamel furnace. Thus the foundry has needed to be actively occupied in research and development to keep pace with these and other new demands, and there is every reason to assert that both in the electrical and other industries the exacting requirements of a new age have been met.

The most severe critic could not refrain from praise after an inspection of the castings used on a modern typewriter. Here, the work must be accurate to the last degree and with a faultless surface.

Some parts are polished ready for high-grade black finishes, others are chromium plated ; in both cases an absolute freedom from pin-holes is essential. The finished article is a highly-priced one and its quality cannot be lowered by the use of imperfect castings. The type-segment, with its numerous sawcuts, calls for an iron soft and easily machineable and yet of sufficiently close grain to prove satisfactory in chromium plating. Foundries have played a worthy part in the production of modern machines of this and similar types.

The growth of the hair-waving industry has placed a large amount of high class and exacting work in the way of the foundry, whilst developments of quite another character in modern transport have led to the employment of castings for traffic signal work, for petrol pumps and garage equipment, and for cast iron roads. Particular reference may be made to the technique required in the production of castings which will satisfactorily withstand petrol under pressure without showing leakage or weeping. When *not* designed by the foundry these may be the source of much anxiety and wastage.

The developments just mentioned, together with electrical apparatus, such as refrigerators and vacuum cleaners, and the growth of unit drives and control in machine shops, have combined to create a very large demand for fractional horse-power motors, and here again there have been elements in design which have been rendered practicable only by foundry experiment and research.

In asserting the rightful place of the casting in modern industry, mention may be made of the cast automobile crankshaft, a triumph of modern research and foundry practice. If this can maintain the place it is seeking to claim, and thus replace a steel forging, metallurgical research and foundry control will certainly have reason to be proud of their achievement.

To sum up the requirements of a modern casting, it must be rigidly true to shape, accurate in dimension, and free from warp, twist, or shrinkage crack. The skin must be good enough to take a highly glossy paint after merely rubbing down, or to withstand polishing and chromium plating. If vitreous enamel is to be applied the metal must be suitable in composition and able to overcome the tendency to fracture or blister caused by irregular design, as well as to be free from surface defects liable to cause the evolution of gas in the furnace. Physically, the iron may have to withstand tensile, transverse, compression, impact, or torsional stress and conform to a Brinell, Rockwell, or Scleroscope hardness. For machining it must be free from hard spots, from blowholes, and from more deep seated porosity. For pressure purposes the machined casting must be free not only from visible porosity but must possess a sufficiently close structure or grain to resist the pressure of air, water, or petrol without signs of weeping. In other directions there

may be demanded ability to resist wear, heat, or acid corrosion. For the electrical industry, the casting may need to have a specified electrical resistance, to be on the one hand highly permeable or, on the other, completely non-magnetic. Recently a lawn mower wheel was required to give the same note as a competitive design. Above all, the casting must be cheap, reliable, and capable of quick delivery.

In considering the value of the casting to the modern engineer, its ability to fulfil the foregoing requirements and its successful entry into new and competitive fields of work, note should be made of the comparative lack of co-operation throughout the industry. It is true that for a generation the Institute of British Foundrymen has cared for the educational needs of the craftsman, and that more recently the British Cast Iron Research Association has rendered invaluable assistance to its members, but there does not exist any co-operative body whose sole object is to further the use of cast iron, to explore and develop new fields, or to counteract by research or propagenda the inroads of competitive materials. Organisations of this type are met with in the industries which mainly consume castings, whilst in America the foundries themselves are so equipped, but in this country research, development and the solution of everyday problems have mainly to be placed to the credit of individual firms. In this respect, the founding industry has been backward and needs further organisation if its position is to be maintained and strengthened.

The subject of the British Cast Iron Research Association to which reference was made a moment ago, is really worthy of more than passing notice. Established under the auspices of the Department of Scientific and Industrial Research, this association has shown a steady growth until to-day it is an important asset of the industry, and is very favourably regarded by the Controlling Department. The membership includes the principal foundries in the country whose technical and managerial representatives comprise the committees controlling various reasearches. The sum of £12,000 was available for research last year, and an aim has been set at a minimum of £20,000 per annum. This sum is small in comparison with the research and development funds of some kindred industries, but, even so, the results already attained have been of universal benefit to our foundries and to their productions.

Returning to the consideration of present day requirements, the foundryman does not complain that these are too exacting, but realises that the imposition of each is a necessary and legitimate requirement of his customers. It would be useless to maintain that the foundry is not still far short of perfection, and equally so to suggest that such an accomplishment is near at hand, but the claim is made that problems are being faced and solved without undue

delay or wastage. Having in mind the challenge of your council, the author is justified in quoting actual figures for the only foundry with which he has intimate acquaintance. It is admitted that being only averages, these are deceptive and may cover serious individual losses, but when it is recorded that in a foundry making 140 tons of castings per week, the total returns from customers over a six-monthly period totalled only 0.6%, there must be general, if not universal, satisfaction with the goods supplied. Nor is this output simplified by comprising only a few standardised and perfected lines, for in executing the orders of over 400 customers, this foundry handles every week no less than 1,000 patterns and 250,000 castings, the orders varying from 5 to 5,000 items per line. An analysis of these rejections shows the main causes to be :—

Porosity and blowholes	0.22%
Hardness	0.04%
Moulding and pattern defects ...	0.12%
Breakages and cracks	0.14%

The art of making castings has at some time been crudely and ignorantly described as " making a hole in some sand and filling it with molten metal." This may have been true in prehistoric times but to-day the products of sand and metal create in the mind of a casual visitor a sense of the marvellous which does not disappear when a closer, even a daily, acquaintance with the foundry is made. The moulder's craft is no mean one and is worthy of a meritorious position in the works produced by men's hands. Particularly in a jobbing foundry, dealing with an ever new range of patterns, there is a demand for unceasing care, vigilance and attention to detail if the effort is to be successful. The solution of the new problems which arise from day to day demands a wide experience and an intelligent application thereof. Fortunately, there exists in the industry a sufficient breadth of both experience and intelligence to enable this insistent demand to be encountered and dealt with alongside the routine matters of the day. There is a danger here, as in kindred industries, that mechanisation and mass production may so react as to lessen the capacity of a growing generation, and foresight is necessary to prevent such a happening.

Practical experience and intelligence will always be essential for the production of castings whose design and requirements are daily becoming more complicated, but unaided by scientific research and control neither the present or future demands can be met successfully. Problems cannot be permanently solved and their repetition evaded solely by the methods of trial and error ; there is required also an understanding of the why and wherefore, the underlying principle. Some of the foundry's most frequently re-

curring troubles have been so long and so often encountered that the craftsman doubts the ability of science to unravel the difficulty and present successful formulae for its evasion.

In the past two decades there has been perfected the analytical and metallurgical control of raw materials; the foundry cupola as an old-established and empirical melting unit has been remodelled on sound principles, and the improved design of moulding machines has increased both quality and capacity of output. These, however, are only the outlying fringes of the subject and vital details are still dependent upon the daily judgment of the craftsman.

In considering the desirable aim and possibility of 100% perfection, there must be considered three formidable obstacles which stand in the foundryman's way. Cast iron is in essence an impure metal; moulding sand is essentially a friable, non-rigid material, and the cupola, although a most adaptable and economic unit, has one great drawback in melting its metal in contact with the fuel. After seeing the slag tapped from a cupola, it must be regarded as a remarkable achievement, and one for which we are largely indebted to nature's law of gravity, that castings equal to present production can, in fact, be made at all. This points attention to the design of gates and runners, which play a vital part in the cleansing of the molten metal, and which remain entirely matters of judgment and experience. In the making of the mould, success is again wholly dependent upon the degree of ramming imparted to the sand, a point upon which science has yet given little light and no assistance in control. Consider again what happens when the mould is filled with molten metal. The sand faces are exposed to a white heat and to the penetrating effect of the metal, and are yet required to yield a casting excellent in surface and accurate in dimension. It may seem a very simple thing to pour metal into a mould and obtain a casting, but metallurgical study leaves the observer astonished that results equal to those obtained are at all possible, since it is revealed that in cooling there are at least three successive expansions and contractions before the metal is below red heat. Complicated chemical changes proceed through various temperature ranges and against the stresses these involve both the mould and hot casting must be resistant. Were it possible to devise a transparent mould, so that the phases could be observed, this would be a most fascinating and instructive study. Instead, the moulder must pour his mould and wait minutes, hours, or days for its cooling before the result can be seen.

Attention is drawn to these points not because the author believes the foundry craft to be more full of difficulties than the trades pursued by his audience. It is doubtful if there is any process or industry perfect to 100%, or in which difficulties once met and apparently solved, do not continue to apear at uncertain intervals, but if there should be such a one, it certainly has the foundry at a

disadvantage. It may be emphasied, however, that the three obstacles mentioned above are in themselves sufficient to prevent perfection being at all a possible attainment, and they are not difficulties which science or development are likely to overcome. To make castings in sand is the essence of the trade. Die-castings, made in metal moulds, are of course, an established commodity and often possess advantages over those made in sand, but these are almost invariably cast in metals with melting points much lower than that of iron. In America, iron castings for carburettors and other automobile work have, for years, been made successfully by the Holley Permanent Mould process, but the author's firm when proposing to become licencees were unable, in this country, to find a prospective market which would justify the capital outlay involved. Neither can the foundry expect to have available metal free from dross or cinder. Furnaces melting metal without contact with fuel are indeed beyond the experimental stage, but there is in sight no development likely to oust the foundry cupola which is both adaptable and economic in operation. As to the complications ensuing from the impure nature of cast iron, these, in fact, constitute the *raison d'être* of the material and are becoming even less simplified by modern alloy conditions.

It would be unfair to create the impression that the foundry complacently accepts these natural hindrances. The quality of work made from day to day is itself a testimony to an unceasing activity on the part of all concerned. Engaged in foundry management there will be found to-day men possessing both talent and training equal to those in any kindred trade. At Sheffield, a degree course for foundrymen is now in being; at Birmingham, the British Foundry School provides an intensive one year's training for young men with some practical experience, whilst the City and Guilds Institute examines and grants certificates for foundry and pattern work. Most technical schools in foundry areas provide suitable courses for the ambitious operative, but if these are not well suported, adequate excuse may be found in the laborious character of the daily task and the very dirty condition in which the foundry worker finds himself at its close. Whilst welfare work in foundries is becoming quite common, it is still unusual in this country to find any provision which would allow the moulder to make himself presentable for evening classes immediately following his work.

To-day, most large foundries possess laboratories equipped for chemical, physical, and microscopic investigations. Additionally, men with technical training will be found in control of melting, sand preparation, and testing, and the examination of castings for internal defects such as porosity. The analytical chemist of earlier years has given place to the modern metallurgist, whose training

enables him to undertake works investigations and to control essential processes.

After the foregoing remarks, consumers of castings now present may naturally begin to wonder why they ever find defective castings. Having admitted the difficulty of maintaining a reliable and faultless output, there follows the necessity to provide for such inspection and rejection within the works as will prevent imperfect material reaching the consumer. Inspection for quality holds a very definite place in works progress and is usually located immediately after sand-blasting, so that faults may be quickly detected and brought to notice of the moulder, and that due credit for his satisfactory work may be placed to his account. Some part of the inspection is simple ; the rejection of obvious scrap from a variety of causes, such as short-runs, blowholes on surface or utter failure to conform to pattern. But in any foundry, and especially in one dealing with light castings, there will always be a proportion of castings falling short of perfection, in large measure from surface defects. The inspection department needs to have a clear realisation both of the standard the producer desires to maintain in his outgoing products and also of the standard demanded by the individul purchaser. Every foundry has it own standard, both in production and inspection, and because that standard is known to the purchaser each firm can attract business in accordance with its capabilities and reputation. The inspection department has to maintain a reasonable and sensible balance between the ideal and the practical as represented by the supplier and the consumer, and this can be done only by men well experienced, not only superficial examination, but in the standard required by both parties. Inspection for quality calls for wider experience and greater judgment than that for dimensional accuracy alone. It may be of interest to mention that in the foundry already referred to, the proportion of work scrapped at this stage averages 6% of that actually moulded. In making a wide variety of work, from an ever-increasing range of patterns, there is bound to be further occasional rejection by the customer, since quality inspection can never be more than human judgment, but the amount of customers' returns given at an earlier stage suggests that in this direction general satisfaction is being given.

It would be tedious in a paper of this description to attempt a detailed description of foundry plant and processes, and our film should do this part much better. Here, it may be mentioned that iron castings vary in weight from 1 oz. to 20 tons, and as the two extremes demand entirely different plant, metal and technique, it is unusual to find any one foundry dealing with the whole range. Exceptions occur where large enginering or electrical works make their own castings. Many foundries are now housed in lofty and well lighted buildings, provided with heating and ventilation, and made

more tidy and efficient by concrete floors. Such shops compare favourably with those used for kindred industries.

Moulds are made by hand or by machine, the choice depending upon the design and size of the job and the extent of the order. A wide variety of machines is now available ranging from those which merely squeeze the sand to others which turn over the mould, withdraw the pattern and eject the finished mould ready for casting. Production varies accordingly, the latest designs having an output upwards of 60 moulds per hour. Operation is by hydraulic, pneumatic, and electric power, the first being by far the cheapest form.

The operation of a foundry involves a large amount of heavy manual work. On a simple squeeze machine making small moulds the production of one ton of castings involves, on the part of the moulder alone, the handling of rougnly 50 tons of sand and equipment, but when the whole foundry routine is considered this figure is increased to 200 tons. Consideration of the time and energy involved in these operations has led to the improvement of moulding machine design, to the mechanical transport of sand and the conveying of moulds to a central pouring station near the cupola. Extensive layout and organisation are necessary, whilst the combination of moist atmosphere, heat, and erosive sand render necessary a heavy maintenance and liberal allowance for depreciation. As in all mechanical plants, the whole scheme is dependent upon the fitness of the mechanism, and the breakdown of a small unit may disorganise the complete shop. Foundries constructed on these lines are growing in number and are apparently successful in economic operation, but a survey of their location and products suggests that in general, these shops form parts of large works which mainly consume their own products and which are in a position to plan for continuous or programmed production. The synchronisation of a number of interdependent mechanical units does not fit in with the operation of a jobbing foundry where the individual orders may be small and varied according to seasonal or competitive conditions. Furthermore, the making of such work involves new problems from day to day—the fitting and adjusting of cores, the cutting of runners and other items of personal attention not possible in a mechanised plant. It is also doubtful if such a mechanised layout, with its divided responsibility, is capable of producing the high grade work for which some jobbing foundries have a reputation. An exception to the latter suggestion is found in certain of the automobile shops, where the manufacture, gauging, and assembly of cores is carried out under such control as to ensure the subsequent success of the job. In these mechanical foundries, where casting goes on all day, the economy of floor space is a very considerable asset when compared with the allowance necessary in a large foundry, where all casting is carried through in the later half of the working day.

In all modern works scientific management and control, production planning and efficient working are matters of the utmost importance. In foundry work schemes of this character are only practicable where there are large repetition orders and considerable foreknowledge of a production programme. The manufacture of jobbing work involving non-repetition lines does not lend itself to such carefully planned production, although every care may be taken to avoid delays due to inefficient equipment or services. Intricate castings require appropriate moulding boxes for their economic manufacture, the provision of which involves an expense not justified unless repeat orders can be reasonably guaranteed. It is in this way that delays occur and that unduly high costs are involved by the use of more or less unsuitable equipment. As far as possible, large production jobs are tried out by experienced men in a separate department so that their smooth working may be assured when handed over for execution of orders.

Although it is not practicable to introduce mechanised methods into every foundry, some of the shops operated upon older principles have yet given earnest consideration to the elimination of unnecessary and redundant effort, and the assurance of maximum production from their particular work. Time and motion studies have been carried out and their results applied to improvement of efficiency as well as to the payment of wages. Graphical systems have been constructed from collected data on the more repetitive operations and these enable prospective times and prices to be estimated. In districts where the trade has been long established, the craftsman is conservative and somewhat suspicious and the introduction of such systems needs both tact and patience. Their ultimate success improves production and ensures that all grades of management become aware of inefficient sections of the foundry.

At this stage, the author proposes to refer in some detail to cast iron as a metal and to discuss some modern metallurgical developments. The raw material from which iron castings are made is known as pig iron and is the product of smelting iron ore in the blast furnace. Pig iron is not a pure metal, but consists of approximately 90% iron, the balance being principally made up of carbon, silicon, phosphorus, manganese and sulphur, decreasing in quantity in the order mentioned. It is not possible to produce pig iron free from these elements, as they occur in the ores and fuel, and are reduced in the blast furnace at the same time as the iron. Thus they form a part of the molten metal drawn from the furnace. Nor are these elements to be regarded wholly as impurities in the sense that they are altogether undesirable or injurious. Pure iron is neither a commercial nor a castable material and the valuable properties of cast iron as a foundling metal are the result of the presence and influence of impurities. Each one has its individual and particular

influence on the properties of the metal, and these being now well understood by the metallurgist provide a ready and reliable method of producing grades of metal suitable for different purposes.

Pig iron, as produced in different localities, is not a standard or uniform material, but varies in analysis according to the ores from which it is smelted, and the design of furnace employed. As each ore field is relatively uniform, competitive furnaces in one district produce material of generally common properties and composition. Modern furnaces and control are to-day capable of making pig iron to analysis specified by the founder ; alternatively, successive casts of iron can be analysed at the furnaces and stacked in grades to be supplied as requisitioned. Pig irons of widely varying composition are required to meet the needs of ironfounders specialising in various classes of work. Indeed, it is almost true to say that all pig iron is good and useful material, provided it be employed for the class of work to which it is adapted. The founder's failures can rarely, with justice, be passed on to the smelter ; they are more often due to the use of a wrong type of pig iron. It is the function of the metallurgist to know the kind of material necessary for the job, and to see that it is obtained.

The production of a soft cast iron for light repetition work is not in itself a difficult problem. Those grades of iron which are most fluid for pouring are also of a soft machinable character and therefore doubly adapted for this class of work. After prescribing the correct mixture, hard spots may yet occur if inferior fuel or a very damp moulding sand be used. On the other hand, engineers ask too much of the foundry when they stipulate that castings required in strong, non-porous or hard wearing irons, should also possess ready machinability. The two requirements cannot be reconciled and the failure of cast iron to fulfil stringent conditions has very often been due to the purchaser's unwillingness to concede a second place to ease of machining. The problem is also made more difficult when the design of a thin casting is complicated by adding bosses or lugs which are required to be free from internal porosity. The type of soft iron referred to above, suitable for uniform sections up to $\frac{1}{4}$ in. thick, is very prone to porosity in heavier sections upwards of $\frac{3}{4}$ in. thick. A harder grade of iron will ensure solidity, but at the expense of machinability. Except under the heading of special irons, there is no *one* grade of cast iron capable of meeting all the conditions and requirements of a pattern with widely varying sections. Designs of this fashion involve sacrifice of solidity or machinability.

Many attempts have been made to evolve a hardness test which should reliably measure machinability, but the only one which unfailingly meets the need is the drill hardness test described by Mr. F. J. Cook in various papers to the Institute of British Foundry-

men. This being a test which mutilates the casting it is not applicable to the routine examination of production work. Foundrymen more generally use Brinell hardness for control, whilst machine shops seem to prefer the Rockwell method which does not deform the specimen. In practice, it not infrequently happens that difficulty in machining is caused by isolated hard spots or chilled edges, which could not be detected by any recognised form of test.

The production of a uniformly soft metal, free from all chill or hard spots, may be ensured by resorting to heat-treatment. This process has been carried out at the author's works for many years and is now an established success so that castings treated by the process are widely demanded and approved by repetition machinists. Not only is the resultant metal softer than any mixture which can be cast from the cupola, but it is so uniform and free from hard spots as to create a confidence on the part of the user in speeding up machines to take full advantage thereof. In this way, Brinell hardness can be reduced to 160 on $\frac{1}{4}$ in. sections whilst still maintaining a tensile strength of 10 tons per sq. in., amply sufficient for the usual run of small components.

Such treatment does not add considerably to the cost of the castings and the expenditure is amply repaid in machine shops.

The production of castings free from porosity is unfortunately a far more difficult problem for the foundry than is the manufacture of soft machinable iron. In practice, this term is used to include defects of various kinds, each with their own cause, but in the aggregate accounting for greater wastage than any other defect in cast iron. The machinist who discovers blowholes just beneath the skin, or deep-seated cavities in heavy parts, or again micro-porosity or weeping on pressure test, classifies all these as porosity, although their causes may be very different. Observation on the part of the practical man and research by the metallurgist have shown that metal composition is only a minor cause, and that porosity may result from incorrect pouring temperature, insufficient venting of the mould, faulty design and indeed a number of other causes. The frequent occurence of porosity and the difficulty of its detection, except by completion of machining operations, is recognised by the founder as one of the most serious drawbacks of cast iron, leading to unfruitful expenditure by the purchaser and productive of dissatisfaction on his part. Claims for machining costs on faulty castings have always been resisted by the founder, but this has not led to complacency or disinterest on his part. The British Cast Iron Research Association has recognised that if by a comprehensive research the causes of porosity could be elucidated and their control made possible, a great service would be rendered to the engineering industry as well as to the foundry trade. Only recently have adequate funds become available for so extensive a research and this

has now been actually commenced. Some years must elapse before its completion.

Designers of castings could render great assistance to the foundry on this point by co-operation and by an endeavour to avoid sharp angles and irregularities of section, such as bosses remotely placed on thin sections in a way which prevents their being fed by hot liquid metal during cooling in the mould. Wherever possible, cores should be used for lightening and making even various parts of the casting. The foundry would also be helped if users receiving samples for approval would not only examine for dimensional accuracy but, in addition, carry through machining operations and complete tests on the job. Any expense so entailed would be amply repaid, as the detection of faults at an early stage would prevent the foundry in good faith proceeding to completion of the whole order.

The trend of development and research in the metallurgy of cast iron through recent years has been mainly in the production of "high duty" irons. This category embraces metals with superior physical properties, able to withstand wear, high temperature, corrosive conditions, or repeated stresses likely to induce fatigue. Undoubtedly, there is a demand for metal of this character, but in practice, the market appears much more limited than would be imagined from current technical literature or discussion.

Metallurgically, the aim is to produce a stronger matrix or background in the mixture, and to refine those coarse graphite flakes which, in every way, weaken the structure of cast iron and lead to its breakdown. Mention may be made of three processes aiming at this result, viz., the development of the rotary furnace, the inoculation process, and the introduction of alloy cast iron.

The foundry cupola has withstood the test of time and development as a practical and economic melting unit. The converted boiler of earlier days has given place to a unit based on engineering and chemical considerations; charges are accurately weighed and air supply is controlled as to pressure, volume, or weight. In the forefront of modern design is the balanced blast cupola patented by the British Cast Iron Research Association, a furnace more sensitive to control and more economic in management than any other type. But in one important respect the cupola fails; modern research calls for iron of close grain and fine graphitic structure, which are difficult to produce except when the total carbon content of the metal is maintained at a figure lower than that previously standardised. In the cupola, metal and carbonaceous fuel are charged together, resulting in a definite tendency for the iron to absorb carbon to a degree above that present in the pig iron. Carbon is a weakening and softening element, advantageous in the manufacture of soft irons, but undesirable in more than minimum content for stronger engineering material. Rotary furnaces, whether fired by gas, oil,

or solid fuel, make possible the melting of metal away from immediate contact with *that* fuel and thus enable iron of lower carbon content to be produced. In practice, the extent to which carbon can be lowered is limited by difficulties arising in casting and by an increased shrinkage which induces stresses or fractures. The rotary furnaces also facilitate the introduction of steel or scrap iron into the mixture without detrimental results, since the entire bath of metal is under close chemical control. Similar reasons make the method an improved one for preparing irons with expensive alloy additions. The continued development of this type of furnace will probably be restricted by its inadaptability to general foundry working conditions.

The discovery and development of the process known as "inoculation" has resulted in the introduction of metal with reliable mechanical properties considerably in advance of those previously attained by any other practicable or mass production method. One of the most important constituents in cast iron is graphitic carbon, which occurs in nodules or flakes varying in size with composition and rate of cooling. Under certain conditions, e.g., very low silicon content in the iron, or extremely rapid chilling by quenching, the carbon does not separate as graphite but remains in chemical combination with the iron, producing a material white in fracture and unmachinably hard. The "inoculation" processes depend upon the melting of a grade of iron much harder than is finally required, and the introduction into the molten metal of some finely divided substances, the grains of which act as nuclei around which graphite of a very fine uniform character is precipitated. The resulting iron possesses greatly enhanced properties and has been successfully used in highly stressed parts, such as automobile crank shafts and connecting rods, thus replacing steel forgings. Perhaps the most important property of such iron is the uniformity obtained in widely varying sections. Porosity is very rare and the physical properties fall little short of malleable cast iron. A number of suitable inoculants have been discovered but the most successful one, and probably the only one in use on a commercial scale, is calcium silicide, the basis of irons now being produced under the patents of the International Mechanite Co. The success of mechanite is probably due not only to the underlying discovery but also to the high standard of technical control which is necessary for its successful application and which the patentees insist before a licence is granted. Various grades give tensile strength between 14 and 22 tons per sq. in. not as freak results, but with a reliability not usually associated with cast iron. Some of the grades which contain alloy additions are amenable to heat treatment and are then reputed to yield as much as 35 tons tensile. Whilst these figures are doubtless both interesting and

valuable to the engineer, it would not appear that there is yet that widespread demand for such materials as would justify a large scale adoption of the process by ironfounders. The degree of control and the terms of licence at the time of writing are not such as permit the iron to be produced in small or irregular quantities as may be required by a small proportion of a founder's customers.

The association of nickel with cast iron has received considerable publicity and is probably familiar to most users of castings. In various ways nickel is undoubtedly helpful, e.g., in the removal of chill in thin sections, in reduction of porosity by permitting the use of a harder base metal, and in association with chromium, whereby increased stability, an iron resistant to heat, wear, or stresses may be produced. Certain nickel-irons produce superior results when heat-treated and may yield up to 20 tons tensile, whilst in higher proportions with copper or chromium there are obtained the non-magnetic and non-corrosive austenitic cast irons. Nickel is an expensive addition to cast iron, doubly so because the founder cannot easily recover that portion which passes into gates and risers and consumers should therefore only call for metal of this type when experiment has completely justified its use.

Time does not allow of reference to centrifugal casting, the case hardening of cast iron by the nitriding process, and numerous other developments designed to increase the usefulness of this material to the engineer. A decade's progress may be measured by reference to standards issued by the British Standards Institution. In 1928, the highest grade of iron included in Specification 321 was fixed at a tensile strength of 12 tons per sq. in.; a specification now under preparation proposes irons with maximum strength up to 22 tons, or nearly double the earlier figure. The perfection of such material, and its reception with confidence by engineers, will permit cast iron components to be designed upon a reliable scientific basis greatly in advance of the empirical method previously in vogue.

It is natural that such new developments should excite the attention of the engineer, especially when he is well in a position to use their results. The founder, too, is anxiously watching the trend of events, desiring to frame a policy sufficiently progressive to ensure his business in future years. Straight cast irons, as produced in the last two decades, have proved extremely serviceable materials and will doubtless continue to be in demand for those wide fields of work which they can adequately fill. The new developments are as yet in limited demand, and the extent of their development is in the hands of the engineer rather than the founder. It should be borne in mind that only the minority of foundries possess that measure of technical control which is essential for the production of these high grade irons. Generally, these are the larger foundries run more or less on mechanised or continuous lines and with

cupolas melting up to 10 or 15 tons per hour. Such a layout does not lend itself to the production of small quantities of special mixtures which are often required in the first case in quantities of only a few cwts. at a time to meet the experimental needs of various customers from day to day. The operation of a large cupola does not lend itself to frequent changes of mixture or to the production of small quantities of metal to close limits of composition, and large scale production is necessary both for economy and reliability. Developments in the last decade have been too numerous to permit any one ironfounder to become a specialist in them all.

In estimating the value or merit of castings a fine smooth skin very often proves of great value. First of all, it betokens good and careful workmanship and creates a favourable first impression with the user. A smooth, clean, well dressed, casting can often present a first class sales service, not only to the actual purchaser, but also to an accidental observer.

The high standard of finish associated with such articles as typewriters, instruments and domestic goods is made possible only by the use of a casting with superfine skin, so that this feature does actually increase the sales value of the casting. In many other cases, the consumer would not be justified in paying an increased price solely to obtain improvement in this respect. In actual practice, is has been observed that such a skin, when removed by polishing, will often reveal pinholes and that when used for vitreous enamelling, there is an increased tendency to small blisters. These defects are due to the impervious character of the very fine sand employed in obtaining this smooth finish.

Comparison of present day castings with those of the last century may suggest that some of the earlier craftsmanship possessed a finish rarely, if ever, equalled to-day. Experience reveals that in foundry work, as in some other metal trades, it is actually more difficult to produce a perfect skin on a flat plain surface than one with an intricate artistic design, of which the detail may conceal small flaws. To produce castings suitable for chromium plating is certainly one of the most difficult tasks undertaken by the foundry. The degree of finish obtained is also dependent upon the type of iron used. Owing to the searching or erosive action of the stronger and harder irons upon the mould surface, castings made in these will rarely carry a skin equal to that on the softer irons, which themselves were more widely used when engineering demands were less stringent.

The production of a superfine skin involves considerable expense. Well prepared foundry sand is essential, as are also first class patterns, whilst the additional care necessary in moulding slows down production. Furthermore, this careful work in the foundry is only made fruitful when followed by thorough sandblasting,

intelligent fettling and rigid inspection. Much of the work rejected in a high grade foundry would be passed by a competitive shop with lower standards. All these details combine to increase cost of production.

The natural moulding sands of this country have been an enormous asset to the foundry trade. Their ready adaptability has encouraged a neglect of research and development of control. The increasing use of moulding machines employing semi-skilled labour and the growth of continuous foundries have compelled attention to be given to the technique of sand preparation and the establishment of tests suitable for works control. The older craftsman, working with his hands, could, in the course of his work, make allowances for variations in his sand which are impossible with machine moulding, where the operator has neither the skill, time, or opportunity to give these points his attention.

The production of well finished castings demands smooth and well polished patterns. The best skin on a casting is that obtained by withdrawing a smooth pattern from a correctly rammed mould. Tooling by the moulder closes the mould pores against the gases which must readily escape on pouring and does not leave the ideal surface on which metal may solidify. It is a mistake to rely upon the moulder to give to his mould that smooth finish which should be produced and left untouched by the pattern. Patterns should be sufficiently substantial to permit of the permanent affixing of necessary runners. The shape and position of the runner plays a critical part in the final cleansing of the entering metal and this auxiliary item should be designed and affixed in the pattern shop rather than cut by the moulder's tool.

Possibly, to those present to-night, accuracy in castings is more vital than finish, and in this direction there is continued pressure for higher standards and narrower limits. The modern production engineer is not satisfied with general conformation to pattern, but requires consistent supplies of castings sufficiently accurate to correspond with machining jigs or other component parts. In this direction, the foundry is certainly able to conform to limits regarded as impracticable a few years ago. For this achievement there are required well designed and maintained plant, careful and intelligent craftsmen and, above all, accurate and durable patterns. It is altogether unreasonable to expect uniform, consistent supplies of castings from worn out or poorly constructed patterns and coreboxes, which themselves lack the fine limits demanded in the finished article. Any high class foundry producing castings to customers' requirements will invariably produce castings to differing degrees of accuracy, dependent upon the pattern available. Poor patterns cause anxiety, disappointment and loss to the ironfounder and dissatisfaction and wastage to the user. First class metal patterns

may seem to involve heavy initial expense but this is amply repaid both in lower purchase price and in subsequent usage.

The practice in the author's foundry is to use gunmetal patterns or moulding plates wherever possible. Some foundries are content with wood, others use iron for cheapness, or aluminium for lightness, but gunmetal excels above all these because it does not corrode, provides a highly finished surface improving with use, and can be readily repaired or altered. Inferior patterns will not stand up to constant ramming in the mould, wooden patterns swell or become loose in joints, iron is difficult to repair or alter as often called for by designers. Again, wooden patterns often involve cores which could be cut out by metal patterns with consequent economy.

With metal pattern plates, moulding machines and pneumatic or electric vibrators, consistent production to $^1/_{64}$ in. on moulded parts and $^1/_{32}$ in. on cored parts, is now possible, and is daily accomplished. No engineer with an appreciation of foundry problems could expect finer limits than these. Many illustrations could be cited where the accuracy of modern repetition castings has enabled machining to be entirely avoided and this benefit could be extended if foundries were permitted to make their own patterns or consulted before the work was commenced. The foundryman brings to the problem experience and an intimate knowledge of his plant, machines, moulding boxes, etc., as well as anticipation of difficulties which may arise. Machinists too, would benefit by visiting the foundry, seeking advice on design, best method of making patterns and possible modifications to facilitate production. Considerable economies have been affected by co-operation of this kind.

It is realised that for larger castings, wooden patterns are without alternative. These should be fitted with metal rapping and lifting plates and if required for continued production should be lined or faced with brass plates wherever intensive wear will be experienced in the mould. The same is necessary for core boxes over which still greater care should be taken, as cores are not fixtures in a mould and, being naturally liable to movement, must, in themselves, be of great accuracy to counteract such instability. In all cases, loose pieces should be of metal, so that rapid wear may not take place. Core boxes should be strong in construction and well battened to avoid movement. Another common fault with core boxes is the provision of insufficient print, compelling the founder to resort to chaplets, which are unsightly and the cause of porosity. Liquid metal exerts a very strong lifting pressure on a core and this must be counteracted by ample core print.

An important point to be remembered by the designer is the advisability of casting machined faces in the lower half of the mould, as these surfaces are always much cleaner than the upper ones, upon which dross may collect. The founder is frequently hindered

in this respect when either designer or pattern maker constructs the pattern with taper in a direction opposite to that best suited for moulding. Many other foundry difficulties would be overcome if designers realised the advisability of simplicity in design, avoiding loose pieces, deep pockets, sharp angles and abrupt changes of section. In light castings any undue insistence on extremely thin sections involves wastage, risk of hardness or breakage and often does not result in lower cost.

It is realised that repetition castings must often possess a particular degree of consistent accuracy so that they may readily follow the machinists' jigs. Drawings very rarely indicate the face from which the job will be set up; if this were done the pattern shop would commence work from the same point and thus help to obtain the required result. Where the jig demands an accuracy which taxes foundry resources, the most important face should never be one made by a core, as this will involve greater risk of variation than a self-moulded part. Care should also be taken to avoid faces across which a joint will run, as these may have two angles of taper and so not present a plane face to the jig. If the jig designer can visualise the point from which the foundry will run the casting, it will be well also to avoid this being a critical part, as fettling may introduce variations in the straightness of the edge or the radius of a boss. Foundries would appreciate the indication of any such important points and care would be taken to give a maximum degree of accuracy. In general, location areas are better if placed on faces which in the moulding will be horizontal rather than vertical. After samples from a pattern have been approved for dimensions, it is now usual to mark drilling centres by dimples which assist the machinist and avoid later work.

In a paper of this description, read before those who actually handle castings, it should be necessary to say little regarding the cost of castings. In the majority of finished products, the actual cost of castings is not the predominant item in final cost; furthermore, the machining and finishing of a casting usually involves an expense above the original cost. The man who handles either repetition castings on expensive machine lay-outs, or intricate individual jobs involving costly finishing, is assisted far more by a casting of outstanding quality than by one of extraordinary low price. It may suit the *buyer* to sacrifice quality to price, but the engineer never gains by such a policy. Enough has been said in this paper to show that the production of a high grade article involves expenditure upon material, plant, and control, which must be reflected in selling price. Any casting of outstanding merit, whether it be in appearance, accuracy, or ultimate service, can thereby justify its first cost, and amply refund this to the purchaser.

Admittedly, there are cases where the finished article itself is of

such poor quality that a high class casting would not be justified, but, on the other hand, there are far more instances where the slightly increased cost of a superior casting would be more than refunded. Nor is monetary recompense the only consideration, the steady flow of trouble-free castings through a factory saves the time of management, avoids delays through wastage and creates a happy relationship with labour. Foundries to-day are equipped with, and exist by, costing systems accurate equally as those in engineers' works; with this definite information their only wise policy can be to sell at prices which are on the one hand remunerative, and upon the other hand productive of renewed and extended business.

In bringing this paper to a close, hope is expressed that the contents may have been both interesting and helpful to users of castings and that, in some measure, it may engender closer co-operation and extended sympathy between the founder and those upon whose orders and goodwill he is dependent for the continuance of his business. In conclusion, the author desires to thank Messrs. John Harper & Co. Ltd., of Willenhall, Staffs, for permission to read this paper and to draw upon experiences gained in their service, and to acknowledge the critical and suggestive help of his colleagues in its construction.

(*Following the reading of the Paper a film was shown.*)

Discussion.

MR. J. E. BLACKSHAW: I think it will be generally agreed that the subject of the paper to which we have listened to-night is one that probably interests everyone either directly or indirectly, for it is difficult to divorce castings from any sphere of activity. From my part, however, I am somewhat disappointed, insomuch as my appetite has only been whetted. I would have liked to have had more detail instead of generalities. My first point is the question of price basis. I would like the lecturer's view as to his idea of price basis, as to whether it should be price per each, or price per weight. We know there are a lot of foundries that work on the "rough with the smooth" basis, but for my own part I like every job to stand on its own legs. My view is that the only equitable arrangement for buying or selling castings is that of price per each. With regard to high pressure castings and cylinders, I would like the author's views as to what range of pressures are embraced by the term "high pressure." The resistance to petrol, etc., was mentioned. Again, I would like the author's views as to what is the most certain pressure test that one can apply to a casting, whether it be air, gases, hydraulic, which, of course, includes water, petrol, etc., or any other medium.

A point was made about there being no real co-operation between the foundry and the designer—I agreed with him entirely on that point. If the designers would only co-operate with the foundry, and for that matter with the machine shops, all production engineers would be rid of many of their worries. Though no mention was made of the matter, I would like to raise a point as to the merits or otherwise of hand versus mechanical charging of the cupola, particularly with reference to the distribution of the charge. One hears a good deal, at least I have read much in the Technical Press about the wonderful results that have been achieved by superheating of a melt. Has the author any experience with same? If so, I would appreciate his opinion as to its merits or otherwise.

I must confess ignorance of the fact that there are three stages of expansion and contraction from the molten metal down to the time when the casting is at a red heat. A little fuller detail would be appreciated. The reference to permanent moulds aroused my curiosity. I would certainly like to hear a little more about them, and if it is not too pertinent a question, I would like to know, or at least I would like some indication as to what charges would be involved. He stated that in his own firm it would be uncommercial, and that, moreover, it was not yet a commercial proposition in this country. I fail to see why such should be the case. Surely

there are enough castings, particularly in some branches to warrant some such method as against those at present employed.

Another item—sand control in the foundry. Now one hears quite a lot about this, but when you go through a foundry the general impression, at least to my mind, is that there is about as much dirt and disorder as one could possibly contrive to have, and, on the other hand, sand control is mentioned. It makes one wonder if there is quite so much in it as some writers would have you believe. Again, is it really a commercial proposition, and is it in fact really achieved. A point I can never reconcile with regard to sand preparat on is the stress that is laid on moisture content, yet you find a foundry in the summer or winter with the doors wide open, if any exist, the wind whistling through, and the consequent variation of air humidity. I can see no point in conditioning sand if left about under such conditions. I have heard of firms which have carried out experiments in regard to air conditioning in the foundry. Have you any experience of this, and if so I shall be pleased to hear of same.

I have another point—the question of concrete floors. Are they really a practical proposition in the foundry? From what I have seen of foundry people, the way they smash things about, I do not think such floors would be able to stand up, and, further, can they justify their cost?

What are your views on steel versus cast iron boxes? Have you any experience with regard to aluminium boxes? In my view if a really satisfactory aluminium box could be brought about, it would be very helpful. When you consider what a moulder lifts, he certainly wastes a good deal of energy in lifting heavy cast iron boxes. Steel boxes are advocated by some, but my experience is that they do not last and, moreover, they tend to spring. The author made reference to castings being made to an accuracy of 1/64th. Well, I am entirely unaware of such, and I should like to know if it is in point of fact possible to maintain it on a commercial basis, or whether it is one of those things which can be done, but never is. I am sorry we did not hear more about foundry plant, especially in view of the strides which have been made in this direction of late.

I would like to hear your experience with regard to core blowing machines. From what little I know, I am not a foundry man, there is a very limited application for core blowers. In our foundry we have a core blower, and it takes a minute to blow, and ten minutes to fill it up. Mention was made of a moulding machine putting down 60 boxes an hour. It certainly is an interesting figure, and I can only say that as far as our foundry is concerned we certainly must be a long way behind. You mentioned the question of

depreciation in foundries—again, a matter of interest, and I would like to hear your views as to what you consider first of all a reasonable figure, and secondly, if it will not take too long, the depreciation you would put on the foundry plant. All the experts, as usual, differ in their views, and so I would like yours.

My last question, but one in which I am particularly interested is what tonnage output per unit floor area can you obtain? I think you mentioned a figure of some 250 tons of castings per week, so that if I had some idea of your foundry area, it would satisfy me on this point.

MR. FIELD: As regards the methods of pricing, although I want to avoid in this paper references to my own company, I would say that our practice, wherever possible, is to sell castings "per each" rather than by weight. We believe it to be the better method for both buyer and seller. An exception has to be made when the inquiry is too small in value to warrant a careful calculation of weight. There are so many factors entering into the cost of a casting which are in no way related to its weight. When this is made the selling basis, some castings are too cheap, others too dear.

On the question of high pressure, we are founders. We do not use high pressure castings ourselves. Generally speaking, if a casting will stand, say, 100 lb., it will stand a higher pressure. The breaking down of a casting is due so often to cavities. We can see the reason when we break them. My experience has been that if a casting will stand 100 lb. it will stand 200. The trouble is, will it stand the first five or ten?

In my experience, air pressure is the most severe form of test. Generally, if a casting will stand an air pressure test it will perform the service required by the customer.

With regard to mechanical charging, we have had long experience and are well satisfied. We are using 10 and 15 ton cupolas with mechanical charging, and have been doing so for ten years without regret at having adopted this method. There is no unit in our new layout with which we have been more satisfied on grounds of both economy and efficiency.

MR. BLACKSHAW: Are you casting all day long?

MR. FIELD: For about six hours a day. We use something like 60 tons of metal per day. We cast from five to six hours, dependent upon which cupolas are in use. With regard to super heating, we have some reason to think that in our own foundry difficulties can arise. I am familiar with the information to which the speaker refers, but am not familiar with anything that has been done in this country. We have reason to think that metal can be too hot—it can be melted too hot and cast too hot. The more general difficulty is to obtain it hot enough.

Regarding the Holley process. If time permitted I could say a

good deal about this. When one considers the output that has been obtained in the American works it is wonderful, but there are no consumers in this country who are prepared to have such quantities of goods. For example, by producing valve guides by the Holley process, the output obtainable per machine is 40,000 per day. We could not find any market which justified the rather heavy outlay which is necessary on the plant. My recollection of the cost of a single unit machine is something like £3,000. We made considerable experiments but did not think it an economical proposition to launch out on large scale production.

The mould travels round a rotary table and is used about once per minute. It passes through about four stages during that process. It is cast, ejected, cleaned off, respread with refractory material, and returns in the ordinary way in sixty seconds ready to receive the metal again.

I believe that sand control is essential in a mechanised foundry. Where one depends entirely upon unskilled labour and cannot afford to stop to teach the intricacies of the moulding craft, sand control is a vital factor. Foundry sand does suffer from exposure to the foundry atmosphere. In hot weather we experience a difficulty and suffer from the drying of facing sand which is exposed to the air. A bigger difficulty due to atmosphere is the condensation of moisture on pattern plates, unless they can be adequately warmed. Humidity is a very great drawback. The moisture condenses on the patterns and they do not leave the mould as freely as they should. In the case of double-sided pattern plates it is not very practicable to warm them, but single sided plates can be warmed.

As regards concrete floors, we have them and we believe in them, and I think we should have them over again if we had to choose. With regard to steel versus cast iron moulding boxes, if we could get steel as cheaply as we can iron, we should use steel. We make our own cast iron boxes but have to buy steel boxes. We can make a small cast iron box at a third of the price of a steel one. We are using many hundreds of steel moulding boxes and we are very, very pleased with their service, but their cost is a great drawback.

MR. BLACKSHAW: What I asked was—which do you consider gives the best results apart from the cost of the box?

MR. FIELD: I cannot see anything to choose. Bought steel boxes are certainly a good job but we try to make our cast iron boxes equally good by planing edges, fitting hardened steel bushes and pegs, and by renewing pegs as required. There is little difference in the weight. Cast iron boxes certainly are subject to breakage, but even so, are very much cheaper than steel.

MR. BLACKSHAW: I am concerned with the output you get from them.

MR. FIELD : I cannot see why there should be any difference. Regarding the accuracy of castings, I can assure Mr. Blackshaw that mass production castings, say, up to 5,000 per week, are being kept regularly within limits of $^{1}/_{64}$ in. Customers demand that accuracy and frequently supply their own gauges for test prior to dispatch. With regard to output per unit area, I have made a rough calculation and would put this down at 200 lb. per sq. ft. of foundry floor per annum. An output of 60 moulds per hour from modern moulding machines is no exaggeration and is being regularly obtained in many Midland foundries. Some, whose products have been used in the construction of this building, would probably welcome members of this Institution as visitors.

MR. BLACKSHAW : I shall have to have a look at this foundry.

MR. FIELD : I will give you a name afterwards. On the question of depreciation, I am not an accountant, but I believe our company has had some negotiations with the Inland Revenue, which have not been unsatisfactory, and the result was that they admitted that there is a greater depreciation on foundry plant than on the average plant. I do not know if it is wise to record this statement.

MR. GROOMBRIDGE (Section President, in the chair) : I would like to know whether you have carried out any intensive experiments with regard to the cutting down of fatigue for moulders. Have you ever thought of any special light alloy moulding boxes in order to cut down the weight a man has to handle ? Have you any figures you can give relative to the substitution of cast iron by the introduction of light alloy castings in any way ?

MR. FIELD : I cannot answer the second part of the question. As regards the first part, we have only tried aluminium moulding boxes in substitution for wooden ones where these have to be removed from the work before casting. They are successfully used in America. Our experience with such aluminium boxes is that when they are removed from the mould the aluminium tended to create a suction and so disturb the mould joint. For moulding with hydraulic pressure by the time one has allowed a sufficient thickness of aluminium to withstand the pressure, the weight is almost equal to a steel moulding box. With regard, of course, to the general question of fatigue, I think the introduction of the mechanized foundry speaks for itself. It was designed to eliminate a great deal of labour from the hands of the moulder and keep him to that job for which he is esentially employed, namely, making moulds. I may say that though his work is lightened he is expected to make a greater output.

The fitting of overhead hoppers to feed the sand, as you saw in the film, reduces the amount of work done there. The sand is lifted for them. The question is, what capital outlay can be met ? To equip a large foundry with 50 or 100 completely automatic machines

incurs very heavy initial expense. Many foundries provide machines which do a certain amount of ramming, which limits the fatigue, and yet they do not feel able to go the whole way and provide machines which eliminate the whole of the work. Machines fitted with gravity roller conveyors are a midway stage in a mechanized foundry and are becoming more and more popular. The great difficulty about a mechanized foundry is that it is only a profitable thing where there are standard products. It cannot be applied economically to foundries which have large varieties at the beck and call of a large number of customers. For instance, it cannot be applied in a trade the demands of which may be seasonable.

MR. JAMES : You might be interested if I told you that we have some aluminium moulding boxes that were used in 1914 and the same boxes are being used to-day. They are about three feet deep and are circular. Further to my remark, prior to these aluminium moulding boxes we got a very small output owing to the weight and we have found we get easily twice the amount with the hydraulic machines with the aid of these aluminium boxes. The hydraulic machines were substituted for ramming machines and the same boxes were used on those. I do not see that much sand appears on them, but if they are left to the moisture they will deteriorate. But ours have been taken care of and they are well worth the money.

MR. FIELD : I am very much obliged to you. On the question of aluminium generally the foundry has to be very careful, because of the tendency for oxide to appear on it. Unless precautions are taken for protection an aluminium pattern put away into store and brought out after two or three months could not be used because it would be covered with oxide which would all have to be cleaned off.

MR. CLOUGH : I should like to ask the lecturer just two questions, if I may. The first is on the vexed question of what should an engineer or an engineering firm pay as a fair price for castings. That was touched on very prominently in the lecturer's opening remarks. Now to us, a fair price to pay is the best price that we can get for a commodity which is equivalent to the highest priced commodity—if you can understand that. In other words the only way that we can get a fair price for our castings depends on whether all the castings offered in tenders presented are of a uniform quality, and I think the main feature about uniform quality is what in fact is the substance or what is the chemical content of the iron presented. Now I would like to know from the lecturer as to whether he considers a mechanical test of samples or a test piece taken from the castings is the fairest way of ascertaining the content of the iron or whether he thinks that the only legitimate way is to get a chemical test which often involves considerable cost. To the ordinary machine producing firm I think possibly the transverse test is the

one usually taken. To my mind it is the most illegitimate test that could possibly be put to cast iron. I think myself that I could produce test pieces of equal quality and get very varying results. I think the tensile test piece has given as uniform a result as can be obtained. But whether that is fair or not I do not know. The other point which I would like to raise is as to the Mehanite castings. Mehanite castings seem to have a very big field in the future. For instance, Mehanite castings can stand a working pressure of one ton per sq. in. internally, but we hope to add two tons per sq. in. without fracturing. and I think myself that that shows that although Mehanite is going ahead and is making its name in a field that may prove very useful there is still something remaining to be done.

MR. FIELD : On the question of the most suitable test for castings, I do not think there is one test which is most suitable for all castings. I think that it depends to a large extent on what you want to do with the castings. For instance, if a man wants castings for heat resistance purposes he is not very interested in their tensile strength. It would be possible to produce many irons that have high tensile strengths which might not be very useful for heat resistance purposes. That man would be best advised to put them under a chemical analysis, and would be much more likely to get the material that he wants. The man who deals with relatively small castings for machining purposes would be much better advised if he relied on the Brinnel test because that is the property he is mostly likely to be interested in. To tell him that his components which are a few inches in size have a tensile strength of so and so would not be much good. He is much more interested probably in rapid machining, and I think he would be much better advised to use a Brinnel or hardness test.

If a man is making large engineering components he is much more interested in strength. He had better leave the question of composition to the iron foundry.

As between the transverse and tensile strengths, I do not think there is any question. The transverse test is the better test to use for strength. You should not impose upon the ironfounder mechanical or chemical tests, unless you know that a particular element or item proposed is essential to your requirements. You are unwise to specify some analysis which may really make the product far more expensive, or which may not be practicable. No iron foundry can produce a large number of analyses to meet the needs of every single inquirer.

It is a not infrequent thing for a customer to have a casting analysed which has come from a previous supplier and to require that analysis to be copied the third decimal place. You can only offer the nearest analysis which you may have amongst your standardised metals. If the speaker wants to know what is the proper

price to pay for castings, well it is a very good thing for some of us that the cheapest castings are not sold universally. There is still a market, as in other products, for good things at the right price.

With regard to Mehanite, I think I had better be somewhat conservative in what I say, because it is a patented product which is being sold in this country. Prom what I have seen of Mehanite I have very little criticism to make. I have had the opportunity of seeing it made and handling it, although our own company does not make it. I think that up to the present it is the finest grade of cast iron that has been made.

MR. OAKLEY: With reference to the author's remarks about Mehanite it is of interest to you to state that the company which I am with have had a fair amount of knowledge and experience with the use of Mehanite. We have found that in the course of manufacturing a considerable amount of costs have been saved on the actual finished product, although we have had to pay more for the Mehanite itself. Its machinability is much in advance of ordinary cast iron. It is almost free from porosity, and another great fact with Mehanite is that you can heat-treat it up to the tensile strength of many grades of steel. That, I think, cannot be done with cast iron as we know it. Another big factor is, of course, in the design-ability, and you can also reduce the size of your components considerably. I would point out this particular instance. We made a special gear some time ago for a certain company in the Midlands and they found that this particular gear was giving trouble. It was overweighted for the design of the machine. We happened to hear of this Mehanite and we at once got in touch with these people and they produced us a gear which was something like 35% less in width of face, the diameter of the bosses was of equal proportion, and also the webs. We actually got a cheaper casting really than we did with cast iron. The cost was reduced considerably, and the machine tools were greatly improved because we were able to get on with the cutting, turning, and heating much better than we did with other castings. In addition we had no trouble with porosity, and the result is that we now execute a large number of conveyors where shock is a very important factor. Where the load is always changing it is most important that the shock factor is very well considered. We have found that Mehanite has given us very fine results, and I believe it is getting well known in our industry. As a matter of fact, I know a firm in London that has power to work this patent, and I believe their business is going ahead enormously. I only mention this for the benefit of other members that are having difficulty with castings and do not mind paying a little more to start with. The initial cost is more than paid for by the machines and also in weight and in proportion to the size, because

sometimes it is very difficult to allow for certain components and it helps if you want to get hardened surfaces, as it can be heat treated.

MR. FIELD: With regard to Mehanite, as I have mentioned in my paper, the conditions under which it is made ensures that the best results are obtained. No company is allowed to make it unless they do very good work to begin with. I believe I am right in saying that the only grades of Mehanite which can be successfully heat treated are those which also contain alloy additions, and some cast irons which contain alloy additions can also be heat treated. Some of the grades of Mehanite incorporate nickel and chromium in themselves, and I think I am right in saying that it is those that are amenable to heat treatment.

MR. SALMON: I have listened with the greatest interest to the lecturer to-night, but I should like to ask his opinion regarding cast iron moulds for the future, and also his opinion as to cast iron moulds for the future, and also his opinion as to cast iron moulds against bakelite. My opinion is that the cast iron industry will have to look to its laurels. I think we can see 50% of the cast iron moulds being replaced by bakelite in the future. I should like to ask the speaker's opinion on that because I have one or two instances in mind where manufacturers have begun using bakelite instead of cast iron. It has been used even for bedsteads and also radiators which were previously made of cast iron.

MR. FIELD: In reply to your question, I mentioned in the paper certain directions in which cast iron has obviously become obsolete. But surely it is apparent to all people that the output of castings in this country is growing year by year. Any statistics will show that the total output has enormously extended in this country. With regard to the extent to which cast iron will be replaced by bakelite, we have a very large variety of patterns, some of which I can see being replaced by bakelite, but some I cannot. Take heat-resisting cast iron which is used for types of electric cookers. I cannot imagine these being replaced by bakelite. There are so many directions in which I cannot see bakelite superseding us at all. I am sure that the foundry output in this country is growing year by year. If one looks at the large numbers of jobs made in mass production foundries on a vast scale and sees how busy these are kept I definitely cannot see myself any sign of cast iron being cut out, although I can see some directions in which it is being replaced. On the other hand I can see far-reaching extensions in the use of cast iron for many years to come.

MR. SALMON: But it struck me from your lecture that there were a great number of moulds that could be replaced.

MR. FIELD: They have not been replaced up to the present.

MR. LEWIS: First of all with regard to skin finish I would like

to ask the lecturer if he considers that the finish that you give to the mould by the use of prepared sand is considered more important than the particular type of iron used in getting that finish. I also heard him mention in the course of the lecture something about the type of ingate used, and I would like to ask whether there is a particular ingate which he uses which he has found gives a better skin finish than if you have an ordinary type of straight run up. Then also with regard to the cupola. He said that he runs his cupola for six hours per day. I would like to ask him how many days it works at six hours per day. In that connection I would, if the question is not too pertinent, like to ask the internal diameter of the cupolas which he finds to be most efficient and which will run the greatest number of hours.

I was very interested in the form of sand conveyor shown on the screen just now, and I would like to ask the lecturer if he has made any experiments on the particular angle at which the hopper works, particularly the hopper that travels round the shop, and if he has experimented with different angles with that type of hopper, and also if he has found that any particular angle is best.

I suppose that everybody is familiar with the following problem. When you empty the hopper you always get a certain amount of sand sticking to the side of the hopper. I wondered whether there was a hopper which cleans out automatically, in order to save the trouble of having to lift them about when you are having to prepare a large number of patterns. Has he any experience of hard metals giving a Brinel of 140, 10% copper and the remainder aluminium, and heat treated Brinel of 130-140? Also has he ever tried any magnesium base alloys with 8 to 10% aluminium and the rest magnesium and used this for core boxes and as patterns? My own experience is that in hand rammed core boxes that particular alloy stands up very well.

One other point in the moulds that we were shown on the screen—the picture was rather quick, but I noticed that the operator bent down when working and picked up some sand with a shovel. I would like to ask the lecturer whether he found it was necessary in producing the skin finish on the castings shown to have some prepared sand next to the mould for covering the pattern, or that part of the mould which has to be used for facing the casting, and whether he uses sand from the floor for the purpose instead of using sand straight out of the hopper. I think that is very important because those of us who are concerned in getting a good skin finish are greatly interested in this. If you have to carry the sand about and use it to face moulds it is best to run the hopper round the shop and use it direct.

There is another point the gentleman who opened the discussion spoke about and that is the 60 moulds per hour. We are all very

interested in that. I would like to ask the lecturer if this time of one minute for one mould is taken as the time from floor to floor for two boxes, or if the time is only taken for filling up the sand. I know that one foundry fills up a large box 3 ft. × 2 ft. × 8 in. to produce anything up to 200 or 300 moulds a day in forty-five seconds, but this is only the time taken in the filling up of the box, and then the box is taken to the next operator. It is my opinion that it is fair to take in the time taken to fill the box, place it in the pattern, pass it over to the fellow who mucks about with the sand, lift the box out again, put it down on the floor, and get the other fellow to poke about with his fingers. I should like to ask the lecturer if the sixty seconds per mould includes all this playing about or not.

MR. FIELD: Well, sir, you asked me whether the material is more important than the mould. I think that question is easily answered because if the mould is a poor one it does not matter how good the material is you cannot get a fine skin. If the mould is poor you cannot possibly get a fine casting. You need both really to get a tip-top casting. The ingate depends on what kind of casting the speaker has in mind, small or big. The cupola is run every day for about twelve months before it needs to be relined. As to the economical size of the cupola, if you want 60 tons of metal there is a minimum size that can be used. We are running a 15 tons per hour cupola without any serious drawback. It has given us little trouble and it is certainly superior in quality to any other cupola that we have ever had.

MR. LEWIS: Pardon me, I asked if you would be kind enough to let me have the inside diameter.

MR. FIELD: I think the present one at the charging hole is 56 in., but I should be pleased to give you the other details later. With regard to the angle of the hopper, the one you saw over the moulding machines could be improved on, but the need for replacement through wear and tear has not yet arisen. The moving hopper which drops the sand gets a jerk from the bottom, having a loose bottom which is controlled by a wire rope, and by this means the sand is emptied without difficulty. I cannot see any way of emptying a fixed hopper effectively other than by a vibrator. As regards alloys, composed of 10% copper, we have used these, but I would like to say that in our experience aluminium plates will not stand up to the pressure unless you can get them very thick. We have had a lot of trouble with aluminium plates bending. It is only the facing sand which is delivered to the moulder by the hopper—that only covers the pattern face. The sand that is being shovelled up is the filling in sand. With a mechanised foundry, the whole of the sand is carried to the moulder.

With regard to 60 moulds per hour. This time does not include

the pouring of the mould. The mould is finished with when it goes to the conveyor.

MR. PUCKEY : Mr. Field opened his remarks by stating that he was rather perturbed by the attitude of the Council towards his industry. My own view is that the cast iron industry does not need any help if it has many exponents as able as Mr. Field. I always think it is rather marvellous to note the accuracy to which castings are produced when one considers the rush of molten metal pouring over what have been crudely expressed as "a hole in the sand."

I feel that one of the most singular developments that could be made in the foundry is a general clearing up of the place and making it look a little more tidy. This activity might be given more attention than has been given formerly, and I was very glad when Mr. Field mentioned that they are appreciating that fact now in his own foundry.

I was rather surprised that Mr. Field did not deal more with patterns. In my experience 90% of the troubles that have been experienced in the foundry with regard to bad castings have been due to the fact that a lot of users insist on making their own patterns. They say, and invariably they are right, that they can get these patterns made very much cheaper. They give you their pattern and expect you to use it. It does seem rather essential that the foundry be permitted to make its own patterns.

Another point which is of great interest to me is in connection with the co-operation between the foundry and the user on, for instance, the question of location points. Invariably when we get castings we have to machine them, and to machine them we have location points. It does therefore seem to me that a lot can be done by having a little discussion after the order is placed and having some duplicate checks or fixtures made by the user or by the foundry, both the user and the foundry to use these checks as checking means so that they do know that when castings come into the factory they are at least fairly uniform at the points where they are required. I do feel that a lot can be done to eliminate some of the recriminations that now take place in this direction.

I am on my feet primarily to propose a vote of thanks to Mr. Field and I am sure we all appreciate the manner in which he has given his lecture to-night and also the very able manner in which he has answered our questions, and I would be very glad if you would support me by showing this vote of thanks in the usual way.

MR. FIELD : I am very much obliged by the vote of thanks given to me by you all, but doubt if the discussion has solved any of your problems. Your castings are still as bad as they were when you left them to-night. I am extremely obliged to you, gentlemen.

ANNUAL DINNER, YORKSHIRE SECTION.

THE Annual Dinner of the Yorkshire Section of the Institution was held at the Hotel Metropole, Leeds, on Saturday, March 7, 1936. Colonel George Bray, M.C., T.D., Section President, occupied the Chair, and there was a large attendance of members and visitors.

The toast of "The King" having been duly honoured, MAJOR GEOFFREY H. KITSON (President of the Leeds Chamber of Commerce) said: After presiding at the Dinner of the Leeds Chamber last night, I am glad to be with you and to have the privilege of proposing the toast of "The Institution." I have seen a good deal of the literature relating to the Institution, and have had the opportunity of a talk with my old friend, your president, Colonel Bray. I do not intend to dwell on the work of the Institution, which you know all about, but to refer to it in relation to one or two other activities.

It appears to be your first and foremost duty to provide yourselves with technical and practical knowledge in connection with all classes of engineering production, and to give attention to the equipping of young people going into the industry with suitable education. It is clear to me that a good general education is certainly necessary for engineers in all walks of life.

With regard to the new Education Bill, now before the House of Commons, I would draw your attention to the interest which the Leeds Chamber of Commerce is taking in that Bill, and point out that in view of the fact that pupils will be longer in the elementary schools than heretofore, it is essential that the extra time should be utilised in fitting them for industry and commerce. What is required is to sort out the pupils at an early date, and to take advantage of the secondary schools, the Institutions for higher education, and the Universities, whilst the remainder should be taught something which would be really useful to them in after life.

The Government in its recent programme has set aside considerable sums for technical education, making that branch almost the core of the new advancement of education for the country; much can be done also in the factories themselves, not only in the engineering trades, but in other trades. Better schemes of education in the factories, coupled with really sound work in the technical colleges, will provide a much beter basis than the one on which we are working at the present time.

I understand the Leeds Education Authority has already advanced a little by starting certain useful classes in citizenship and similar subjects in the elementary schools. I hope the members of

this Institution will agree that real practical work can be done between the ages of 13 and 15. I congratulate the Institution on the work it is doing, and am glad to hear of the rapid extension that has taken place during the recent years in your membership, and hope it will continue. I couple this toast with the name of your National President, Lord Sempill.

LORD SEMPILL (President of the Institution) said : It is a pleasure for me to be here this evening and to reply to this toast—our toast—proposed by the President of the Leeds Chamber of Commerce. I have many interests in common with Major Kitson and know many of his relatives, who are leaders of industry in other spheres. I know what a difficult job he has in the activities which lie before him as President of the Leeds Chamber of Commerce.

As President of this Institution it gives me very great pleasure to be able to tell you how glad we in London are to know of the definite progress which has been and is being made here under your president, Colonel Bray. I must pay the highest tribute to the activities of this section and I am sure the Council particularly join with me in that. As you know, a meeting of the Council of the Institution should have been held to-day in London, but due to the fact that this function of yours had been organised for to-night it was the unanimous wish that the Council meeting should be postponed. It shows you more than any words of mine the very high regard in which the Yorkshire Section is held.

In the few words that I addressed to members at the Annual Dinner of the Institution, you may have seen from the report in *The Journal* what I said about the general progress that is being made, and I am not going to survey that ground again. It is satisfactory to find that the progress then broadly outlined has been well maintained. In the Papers issued to the Council for the meeting next Saturday there are 125 applications for membership, which is a record, and I am sure you will be pleased to hear it. Firms applying for affiliated membership include those represented by your president, Colonel Bray, your past-president, Mr. Young, and your president-elect, Mr. Scaife. You will therefore see that they are pulling their weight.

I greatly appreciate this prompt response from Yorkshire, Sheffield, and other centres, to my suggestion that we should use our affiliated grade of membership to make the Institution better known amongst industrialists. I know that some of our members are a little afraid of risking our independence in broadening out in this way. In my view, we can safely move along this line, sure that the best interests of the Institution will be adequately guarded by our Council.

Now, our members have always rightly regarded our organisation as a valuable asset in the industrial life of the country. This was

never more true than it is to-day. Attempts are being made to organise industry in all directions to cope with the requirements of the future. The Government considers it necessary to reorganise our defensive facilities, so sadly lacking to-day. The Government have gone to the leading technical authorities, such as Lord Weir and others, for the best advice they can get as to how the national resources can be organised to the best effect to get what is needed in a very short space of time. I have had the pleasure of working with Lord Weir for very many years. His feelings are in sympathy with us and he is looking to us and other kindred organisations to help in speeding up in a technical sense. In this connection, I think it is necessary to see to the recognition of the specialist branches of knowledge. Personally, I have, with all of you, the most profound belief in the tremendous future which lies before our Institution. There is no doubt about it—like your section here—we are going forward to a very important future.

I was very much struck by the remarks of Major Kitson regarding the question of the lack of skilled personnel which is a feature besetting every industrial centre. Leeds is not the only one. It faces all other centres of industry. I was struck by that to-night particularly because I was reminded of the fact this evening with very much pleasure and very unexpectedly by a very old colleague of mine whom I have not seen for some twenty-five years. We worked together in a certain works not very far from here. He was in a position of technical control and I was merely in the position of one of several apprentices under him, as we were very proud to be. I must say that if I could do it again I would be very glad to go back to-morrow to my apprenticeship days of 6s. per week, plus overtime. We learned a great deal and I shall never forget it. It was at the Rolls Royce factory at Derby. There is a lot to be gained from such an apprenticeship system. To-day it is a thing of the past. My friend's name will be very well known to you ; he is the Chief Inspector at David Brown's, Mr. Milwain. The fact that I saw him here to-night reminds me of the remarks I made in my presidential address regarding the oldest industry in this or any other country, that of agriculture. It is interesting from this point of view, that the Government are looking anxiously to the mechanisation of agriculture on a very large and modernised scale. A lot of our members are certain to be interested in that.

I have to thank Major Kitson for the cordial way in which he has proposed our health. I trust that always, here and elsewhere, we shall use every means in our power to live up to the high reputation he has given us and his hopes for our future.

Mr. J. D. Scaife (Past-President) who proposed the toast of "Our Guests," said : You will have gathered a little from Lord Sempill's remarks of the growing importance of this Institution

in the economic world—how the Institution has grown, step by step, until it is quite capable now (in its own estimation, if in no other) of taking on almost any work. You will probably have gathered from various speakers in the past that there would soon be no limit to our activities—that we might expect to teach Lord Nuffield and Sir Herbert Austin how to make motor cars, Sir Alfred Herbert how to make machine tools, and the Government how to organise production in preparation for the next war. In fact, I have already heard it suggested that Mr. Hazleton is to be sent for and told : " Arise Sir Richard and make that Institution of yours into the Ministry of Munitions, and then all will be well." Mr. Baldwin will light his pipe and as he goes off to sleep will be heard to whisper " Leave it to Hazleton ! " Mr. Hazleton, I see, is on the toast list and no doubt he and others will be bursting with a desire to say a lot of nice things about us.

I am sure we are all pleased to see the Vicar of Leeds, Canon Elliott. It is a very happy innovation to have the Vicar of Leeds with us this evening, and I should like to seem him at more of our Institution meetings. It would probably have the effect of making the Institution turn over a new leaf. If the Vicar would come here more frequently and do his stuff, what a glorious opportunity, what a virgin field, and what a harvest ! I do not know what other speakers would feel about having to put their pencil through some of the spicy things that go so well with an after-dinner speech. Anyway, if the Vicar notices any awkward gaps, or misses any spicy stories from our speeches, he will know he has only himself to blame. He must fill in the gaps from his own imagination.

Then there is Mr. Young, first President of the Yorkshire Section. Mr. Young is one of the strong silent men of the Institution. I liken Mr. Young to the thin layer of ice which slowly expands and turns mountains over. Mr. Young has fought hard to get our Institution going and has done invaluable work in Yorkshire. He represents a very strong force in the Institution.

Regarding our other visitors, we welcome them all. I have just met Major Kitson for the first time. I could probably tell you more about him if I knew him better. We welcome him, anyhow, and all our other visitors who have honoured us by their presence.

You have heard a great deal, since business became brisk, about the shortage of skilled men, but for many years skilled men unfortunately were six a penny. They were roaming about the streets looking for work. Now the nation cries aloud for them. Apprentices grow into skilled men when given the proper training. I want to ask you this : How many of the boys who come under your observation, and who are in receipt of apprentices' wages, are given the sort of training which will turn them into skilled craftsmen ? I believe there is not one boy in fifty receiving apprentices' wages who is

getting anything like a scientific training, a training to make him into a skilled man. They are, in the main, kept on the work which pays the employer best. Apprentices' wages, therefore, are nothing but the exploitation of cheap labour in a large majority of cases. With modern methods of manufacture and specialised industry a boy can be as good as a man in a year or two and it is extremely unfair if that boy is kept on a particular job until he is out of his time and then thrown out onto the street because his hands and mind have not been trained to handle a sufficiently varied class of work. I would like to direct your attention to that problem and ask you to use every endeavour to see that apprentices get a proper training. My managing director, Mr. Clapham, is sitting next to me and I do not know what he will think, but I feel sure he will approve of my remarks. Our Institution can hardly do better than direct its attention to this problem ; perhaps not officially, but, at any rate, unofficially. I ask you to drink to the health of " Our Guests."

Rev. Canon W. Thompson Elliott, M.A. : I should like to say first of all on behalf of myself and the other guests how very much we appreciate the opportunity of enjoying your hospitality and in taking part not only in the good meal you have provided for us but in the fellowship of this gathering. I am sorry if my presence has cramped Mr. Scaife's style. If he let himself go he might be a little outrageous. There was sufficient hint of that in his speech to-night. He appears to be a man not easily discouraged from saying exactly what he thinks. I appreciate very highly his suggestion that nevertheless he would welcome my presence at other meetings besides this dinner to which I have been very kindly invited this evening. It is a very great advantage to me to have this sort of contact with the business and professional men of Leeds. I get to know a good deal more about the problems and conditions of the professional life of Leeds than most of you know about mine !

There was a very distinguished bishop of the American Church who on one occasion accepted an invitation to preach the end-of-term sermon at Hobart University. When he got up to preach this sermon he thought of a bright and original idea of treating the word Hobart as an acrostic—H for humility, O for obedience, B for bravery, A for aspiration, R for rectitude, and T for truth. He spoke for an hour and twenty minutes. On the way out one member of the faculty said : " That man had very great fluency of speech." His colleague replied : " Yes, I am damned glad that his sermon was *not* at the Massachusetts Institute of Technology ! "

When I received the invitation to be here to-night your chairman said he would like me to reply to the toast of " Our Guests " at the Institution of Production Engineers, Yorkshire Section. Knowing nothing whatever about you, I thought I might employ the method

of the acrostic. I thought of these four or five headings, firstly Institution, secondly Production, thirdly Engineers, fourthly Yorkshire, and fifthly Section. I did get so far as to outline a sort of homily which had those five headings. But that I will spare you, for I have made a few notes of previous speakers' remarks and could talk about them for quite a long time! For example, about technical efficiency—if I were to judge by my own experiences, I could say some strong things about that. It is not surprising that the man who has got first-class equipment for his job can get to the top of the tree. The average efficiency in any job is nothing like so good as it ought to be—not in my own profession nor in any other.

Regarding what Major Kitson said about vocational training; it is a very thorny question as to how soon you ought to begin vocational training. It is all very well for those who are interested in getting a pool of skilled labour on which they can draw when needed and leave alone when you don't need it having men walking about the streets at six a penny. Some people advocate vocational training before the children have left school. It is a doubtful policy.

The function of education is primarily the training of the mind, and it is not of the least consequence whether the particular instrument of education which is used in the training of the mind has a direct application to the job you are going to do when you have finished. The right sort of education trains body, mind, and soul up to, say, fourteen or fifteen, then from seventeen to eighteen the technical school develops a mind which can be used and applied to whatever specific job a boy is going in for.

I thank you very much for the kindness with which you have received me. It is a very real pleasure to me to have this opportunity of coming and making contact with you.

Mr. Richard Hazleton (General Secretary): I listened with envy to the speech of Canon Elliott. He told you—I wasn't quite sure whether he was saying it with regret or with relief—that he knew very little about you. My trouble is exactly the reverse. I know too much about you, and although Mr. Scaife told you that I was bursting to say a lot of nice things about you, I am going to begin by a criticism of the Yorkshire Section Committee and then go on to warn Lord Sempill of certain suspicions I harbour about the designs of the Yorkshire Section. First, as to my criticism. Last year your Committee risked putting me on the toast list. This year they seem to have deliberately inflicted me upon you, putting you all in the same unhappy position as the man whose wife had died and who when told that his mother-in-law was to ride in the same carriage at the funeral, said, "Oh, don't do that, it will spoil the whole pleasure of the day for me."

Now, with regard to my suspicions. I have to warn Lord Sempill that there is evidence which could be interpreted as evidence of a deep laid plot to set up within the Institution a dictatorship of the Yorkshire Section. My Lord, you told us to-night that the meeting of the Council which had been arranged for to-day was postponed so as not to clash with this function, and you paid a very graceful tribute to the Yorkshire Section. *But assuming there is a plot*, cannot we imagine the Yorkshire Committee saying to themselves, "Let us show our power—let us forbid the meeting of the Senate, and let us grace our triumph by bringing here—nominally in evening dress but really in chains—the President, the Chairman of the Finance Committee, and the General Secretary, to make a Yorkshire holiday." Now if that were the situation, there is other evidence which would go to corroborate it. Be it noted that the Yorkshire Section will only have at its head men of National Presidential calibre. There is Col. Bray, and now I am told he is to be succeeded by Mr. Scaife, a Past-President of the Institution. I would be very surprised indeed if Mr. Scaife were using the office of President of the Institution merely as a stepping stone to the Presidency of the Yorkshire Section. My Lord, it may be your turn next! (LORD SEMPILL: Why not?) But there is more. Mr. Scaife is also Acting-Chairman of the Finance Committee, the Development Committee, and the Membership Committee of the Institution, and, if there is a plot, it would look as if there is to be an attempt to lay hands on the money bags and the membership. The net is spread very wide. I learn that a former member of the other Yorkshire Section Committee at Sheffield, Col. Sadler, is to be the next President of the London Section. The technical term for that is "peaceful penetration." Finally, there is Mr. Jimmie Young. Mr. Young was not only the first President of the Yorkshire Section but first President of the other Yorkshire Section at Sheffield. He is also a member of the Finance, Development, and Membership Committees. It looks as if we are hemmed in on all sides and are absolutely at the mercy of the Yorkshire Section. But I for one am in favour of making a fight for it, and I suggest, if only we can once get safely across the Yorkshire border, that you, My Lord, go North to rouse the clans in Scotland whilst I go South to see to the defences of the capital.

Behind this banter there is a moral which I wish to point. It is that Yorkshire leads because it will only have at the head of its affairs men with real qualities of leadership. That is a lesson all sections of the Institution would do well to take to heart. In my public life of thirteen years in Parliament I saw one great political party utterly destroyed, and another built up from nothing to take its place, through the leadership of one man. Our Institution is a scientific organisation utterly remote from politics, but it deals

with factors that are vital to the well being and even to the safety of our country. The essential condition of success for an organisation that does that, is wise and steadfast leadership.

At this hour I am not going to make a lengthy speech and I will conclude by associating with this toast the name of your President, Col. Bray. To you he is your leader, your friend, your President, and your guide. To me he is something more. The last time I was here I spent an afternoon with him on the golf course. I had not brought a set of clubs, so he loaned me one. Now, I am not a golfer, and I utterly ruined for him a perfect afternoon, but instead of using on me the language traditionally associated with difficult circumstances on the golf course, in the army, or the engineering shop, what he said to me was, " The next tme you come bring your clubs." And when he wrote to me the other day he said, " Don't forget to bring your golf clubs." There was only one thing I could do to repay magnanimity of that nature and I have done it—I have left my clubs behind me, and if I do go on a golf course at all it will be merely to apply for the job of caddie. I give you " The Yorkshire Section and Col. Bray."

Col. George Bray, M.C., T.D., responding to the toast of the " Yorkshire Section," said : My Lord and Gentlemen, there is one very good rule for the concluding speaker to keep in mind—his speech must be brief. First of all, all members of the Yorkshire Section will wish me to thank Mr. Hazleton and Lord Sempill for their references to our Section.

At our Annual Dinner it is customary for the President to take a little general stock-taking of what has been happening. I think you will be interested to know that our membership has more than doubled during my term of office, and that actually at the Council Meeting next week there are eleven new names up for election, which is not bad for a small Section like ours. Another point which I think we can all modestly take credit for is that we are getting an increasing number of applications from employers. That is very significant, because once an employer is in, it almost follows that his chief executives will also join up. I know there are a disgusting number of my own people in at this moment.

Well now, one of our latest recruits is Mr. Grover, possibly on the principle that " it is never too late to mend." Anyhow, there we are, and very welcome he is. Mr. Sykes of Huddersfield is another. Such members improve our status enormously. Surely the lesson to be taken from that is that at last it is beginning to get known up and down that we are doing a job that is worth doing, and trying to do it decently. There is no question about the value of the work.

If our guests will excuse me, I would just like to finish on a personal note because, as you know, my time in this office is now

rapidly coming to an end. I can confess that when, two and a half years ago, I was " nobbled " by Mr. Young here and Mr. Nurrish, I had not the foggiest notion of what I was in for. In fact I felt rather like what the gentleman of Chicago must feel when " taken for a ride," but one gradually got used to things. I have got very much interested in the proceedings of the Institution and have thoroughly enjoyed my term of office. I have learned a lot, and I think I have made a few jolly good friends amongst you. I have had the greatest fun doing this good job of work.

I would like to thank my Vice-President, Mr. Mitchell, who has been a tower of strength, also my energetic and hard working Committee, and my most excellent secretary, Mr. France. You have heard from Lord Sempill and Mr. Hazleton that we are fortunate enough to have as my successor Mr. Scaife, and another bit of good news for you is that Mr. Grover has consented to become our Vice-President with a view to asuming the Presidency in the following year. I am sure it is most happy for all of us.

I can only conclude by expressing the deep appreciation of all the members of the Yorkshire Section for the support we have had from Headquarters. For two successive years have we had the National President at this provincial gathering. We are very proud and grateful. To have such a distinguished number of guests here is also very gratifying, and so, gentlemen, I take my leave of you and thank you very much—all of you— for giving me such a happy time.

CAPT. L. J. SARJEANT : I am a comparatively new member of our Institution, but I feel I cannot let the occasion pass without expressing appreciation for all Colonel Bray has done for this Section. The mainspring of the Section has been the Colonel, and my hope is that we shall not be divorced from him when he relinquishes the the office of President. I ask you to rise and drink Col. Bray's health and thank him for all he has done for us.